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A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

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Vol. 31. No. 25.

Index to Advertisers and Classified Index Following Reading Matter.

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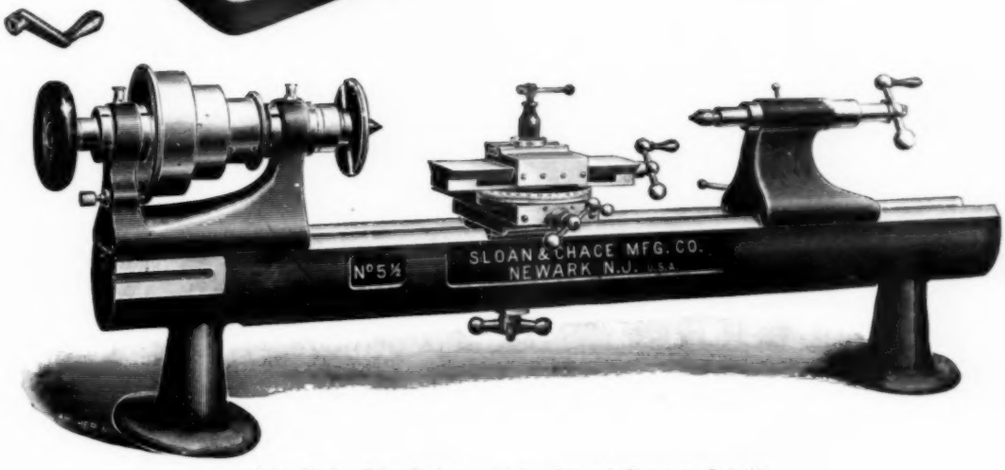

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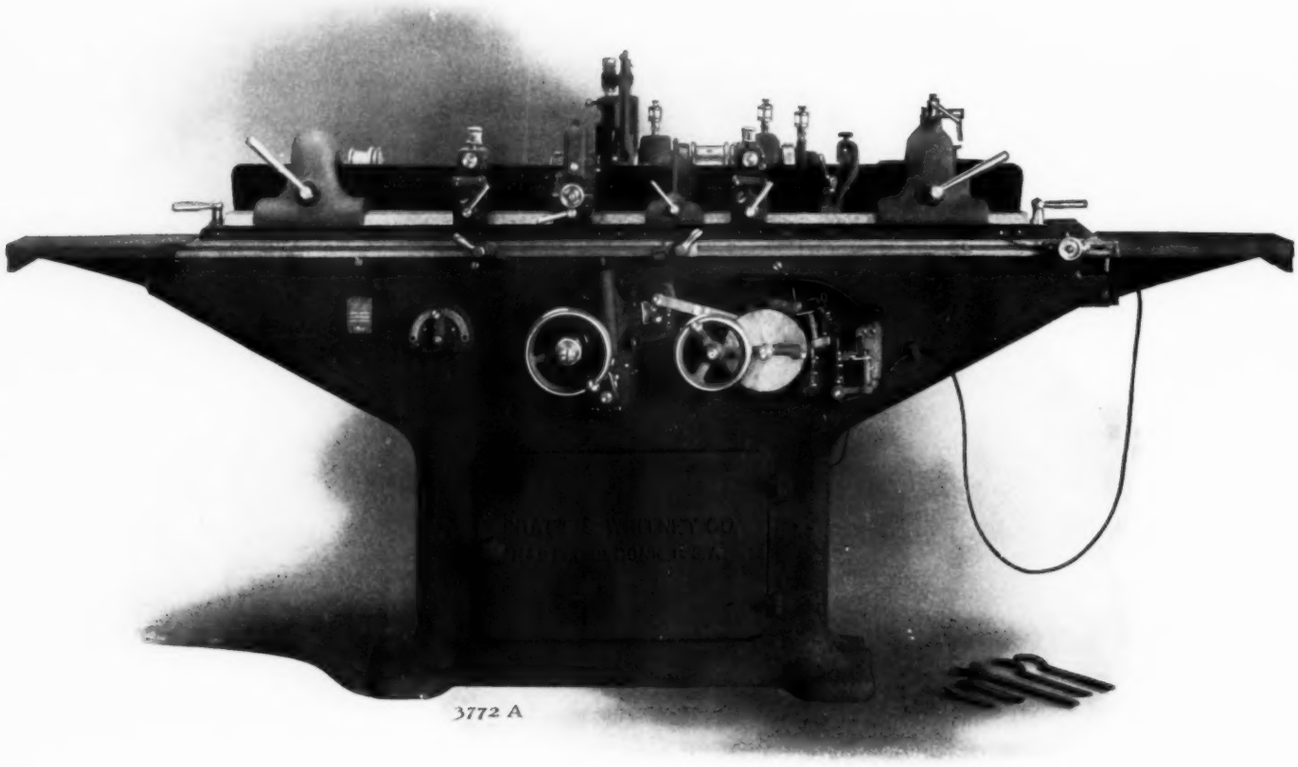

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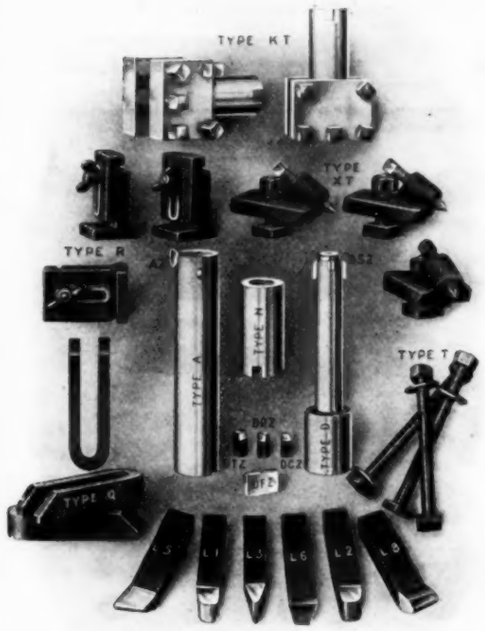

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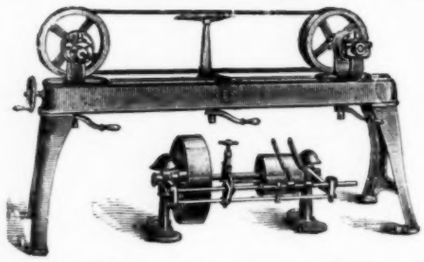

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A Machine Shop Square That Is a Square

The Story of Some Good Seed That Were Sown Thirty Years Ago but Which Falling Upon Stony Ground Failed to Sprout

BY JOHN E. SWEET

One of the editors of the AMERICAN MACHINIST remarked to me recently that he had heard several complaints about the standard pattern of machine-shop squares, and this has prompted me to send some photographs of a square, which, while not new, having been made at the Cornell University shop thirty years ago, is just as good as it ever was, and its merits seem to justify bringing it to the attention of machine-shop men at a time when the general subject of squares is receiving considerable attention.

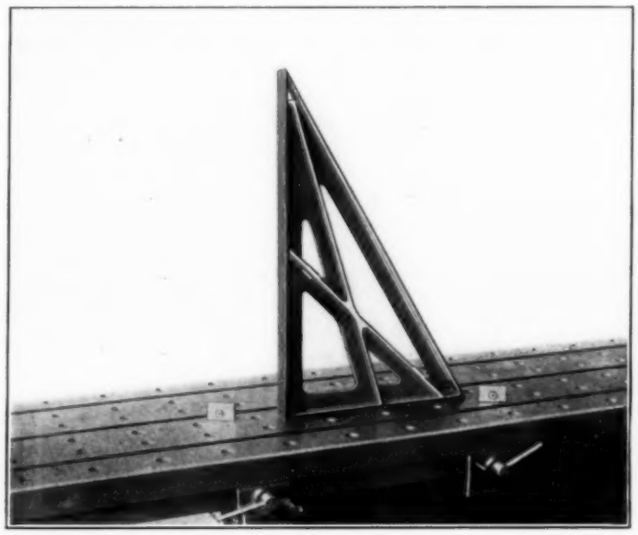


FIG. 1. THE SQUARE AND CLIPS

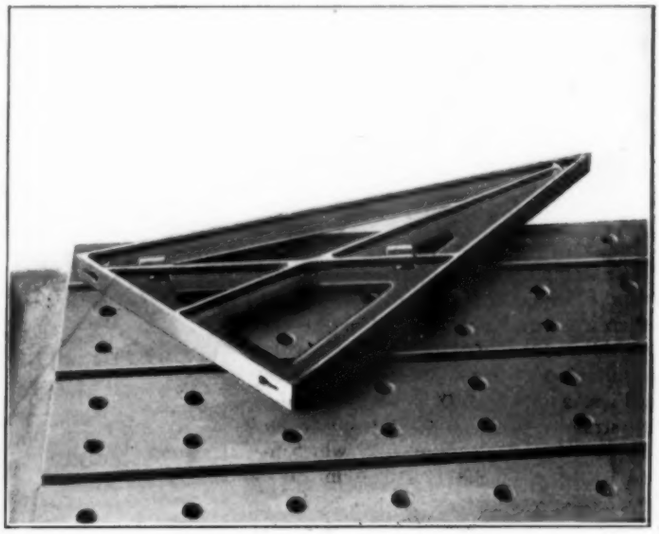


FIG. 3. LAYING OUT ANGLES OF 45 DEGREES

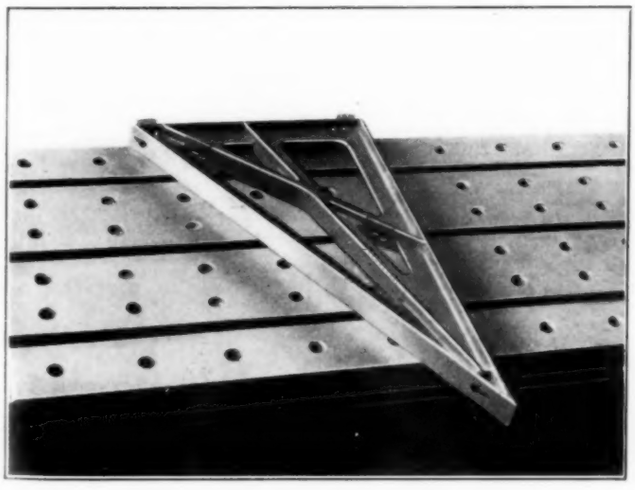


FIG. 2. LAYING OUT A RIGHT ANGLE

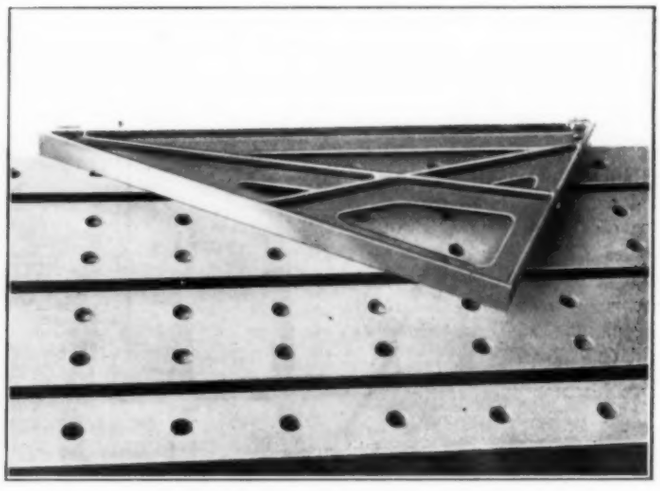


FIG. 4. LAYING OUT ANGLES OF 30 AND 60 DEGREES

PROFESSOR SWEET'S MACHINE-SHOP SQUARE

The difficulties with the ordinary square are due to the blade not being flush with the stock, so thin that when brought up against the work it does not square itself sidewise, and, if knocked or worn out of true, it is neither readily detected nor corrected.

ADVANTAGES OF THE SQUARE

The square shown in the illustrations overcomes these difficulties, and it has the additional advantage that its large surfaces may be used with red lead for scraping. It also gives angles of 30, 45 and 60 degrees with the same accuracy that it gives a right angle. Moreover, it can be made and corrected at home whenever found to be out of truth. Only a first-class scraper hand is equal to the task, but, except for this and an accurate straight-edge its construction requires no appliance other than those used in scraping surface plates or straight-edges.

THE ANGLES ARE ORIGINATED

The squares are made in sets of three, two of which will find ample use in most shops, while the third may be laid aside for a reference standard and be used occasionally for verifying and correcting the others. The reader who is acquainted with the philosophy of scraping will readily understand that a set of three squares which match in all possible combinations

on a perfect straight-edge or surface plate are thereby proven to be correct. A straight-edge is one of three, any two of which when placed together coincide throughout their entire length, and similarly a square may be defined as one of three, any two of which when placed together upon a straight-edge make perfect contact with each other. The angle of 45 degrees may be originated even more easily than one of 90 degrees, and while the angles of 30 and 60 degrees are not quite as easy to originate, they offer no serious difficulty.

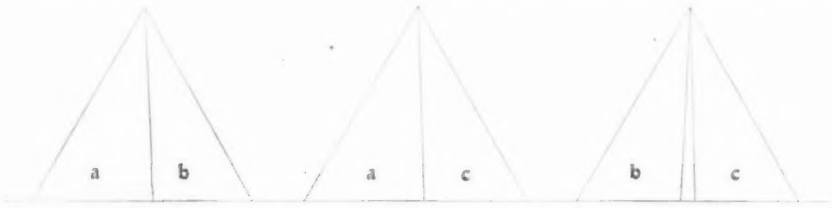


FIG. 5 FIG. 6 FIG. 7

ORIGINATING A RIGHT ANGLE

The complete square is shown in Fig. 1, and alongside of it lying on the planer platen are two clips slightly longer than the width of the faces of the square, which by suitable slot holes, shown more clearly in Figs. 2 and 3, may be bolted against the straight surfaces of the square and against the 45-degree angle rib, which has two raised pads clearly shown in Fig. 2 for that purpose, the tool then becoming a try-square for either of the three angles.

Uses of the Square

Various uses of the square are shown in Figs. 2, 3 and 4. In Fig. 2 the clips have been bolted to the short leg of the square, which is then laid upon the planer platen, with the clips in contact with the edge of the platen, thus establishing a correct right angle across the platen. In Fig. 3 the clips are applied to the 45-degree rib and are then placed against the edge of one of the platen slots, thus establishing angles of 45 degrees, and in Fig. 4 the clips are bolted to the diagonal face of the square, and then applied to the edge of the platen, thus establishing angles of 30 and 60 degrees.

The Method of Originating Angles by Scraping

As the originating of a right angle by scraping is not a common operation, it may be worth while to point out more fully how it is done. In Fig. 5 we have the first step of the process, in which squares *a* and *b* have been scraped to agreement, the angle of one being, however, a little larger and that of the other a little smaller than a right angle. In Fig. 6 square *b* of Fig. 5 has been replaced by *c* which has been scraped to agreement with *a*, the angle of *c* being like that of *b* a little greater than a right angle. In Fig. 7 square *b* has been turned over and applied to *c*, the nature of their contact being plain from the sketch. Squares *b* and *c* are next scraped to agreement with each other, the scraping being equally divided between the two, as near as may be and then *a* is rescraped to agree with either *b* or *c*, the result at this stage being, of course, much better than at the completion of Fig. 7. After several repetitions of this process the squares are made to agree in all possible combinations and they are then correct.

After the right angle has been established the originating of the 45-degree angle resolves itself into the making of two angles which are alike, and the originating of the 30- and 60-degree angles involves the making of the three tools such that these angles in all possible combinations make up a right angle when placed together in triplet with the 30-degree angles together and fit the straight-edge perfectly with the three 60-degree angles together.

So accurately were the Cornell tools produced that when six were brought together on one of the large surface plates they fitted perfectly.

It is so tedious a job to originate a set and so simple a job to duplicate them that it is a pity the Cornell work was not more fully appreciated and its usefulness extended.

Bevel Gear Cutting and an Expansion Arbor

By Arthur H. Gang*

The arbors and gages for cutting bevel gears shown herewith, have been in use in our works for some time and have saved considerable time, besides insuring accurate and uniform work. As the gears are cut with a rotary cutter it is necessary to take three cuts through each tooth, and the object of this device is to avoid setting over the cutter for each gear, but to take one cut through the entire lot of gears, then set over the cutter to each side and finish the lot of gears.

The sketch shows two styles of gears and methods of holding them. A gear like Fig. 1, having no keyway in the bore and the face *A* being the face the gear rides upon (the length of the hub not being of much importance) a cup-shaped arbor with a small key fitted into its periphery is used, and a keyway milled in the gear to correspond with the key as shown. The gear is held in place against the face *A* by a screw and washer. Fig. 2 shows the style of arbor used when the important face is *C*, and as this gear must have a keyway in the bore a Woodruff key is

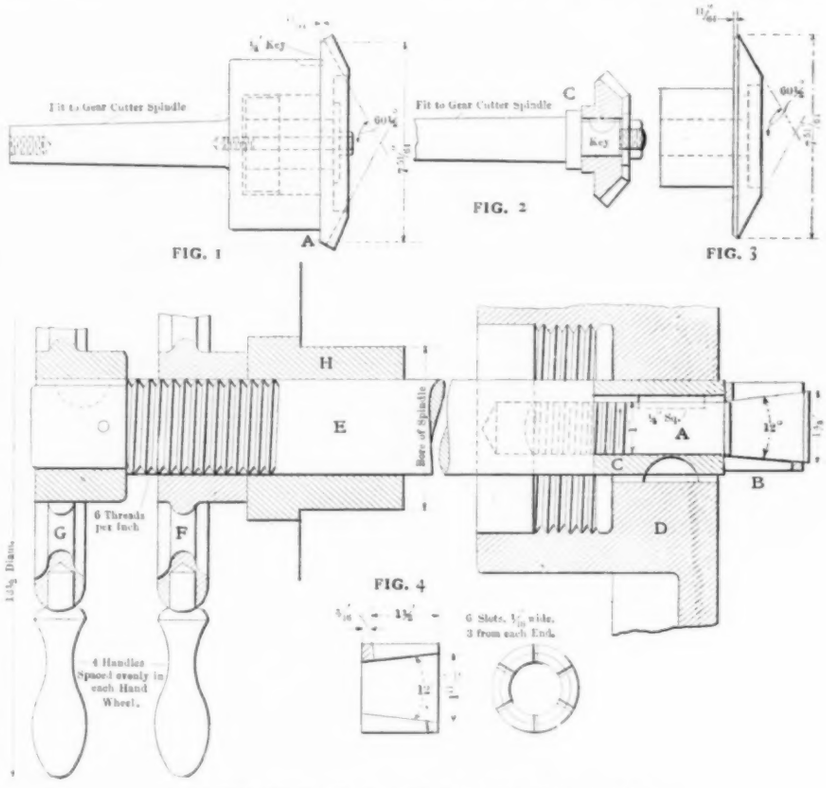


FIG. 1 FIG. 2 FIG. 3

FIG. 4

CUTTING BEVEL GEARS AND AN EXPANSION ARBOR

*William E. Gang Company, Cincinnati, O.

used to locate it. The gear is held against face *C* by a nut and washer.

Fig. 3 is a gage for setting the cutter for the depth of the tooth and is equivalent to a bevel gear with the teeth turned off.

An Expansion Arbor for Large Range of Work

We use the expansion arbor shown in Fig. 4. By the use of suitable bushes it will hold all work from 1 9/16- to 3-inch bore. By providing additional arbors *A*, a greater range of work can be easily handled.

The arbor *A* carries the expanding bush *B*. Bush *C* is a sliding fit in face plate *D* and over *A*, all these members being keyed as shown, so they will turn with *D* and still slide back and forth independent of each other. *A* is threaded on one end and screws into *E;* on the outer end of *E* are two hand wheels *F* and *G*. A fine thread is chased in the bore of *F*, while *G* is keyed and doweled to its place. *H* is a bush fitting the bore of the spindle and supports *E*.

The work having been bored and faced in the chuck is placed upon expansion bush *D*, and by turning hand wheel *G* the arbor *A* is drawn back into shaft *E*, expanding bush *B*, then by turning hand wheel *F*, the work is drawn back against the face plate *D*.

To remove the work from the arbor the hand wheels are loosened and a light blow given the end of shaft *E* drawing arbor *A* out of bush *B*.

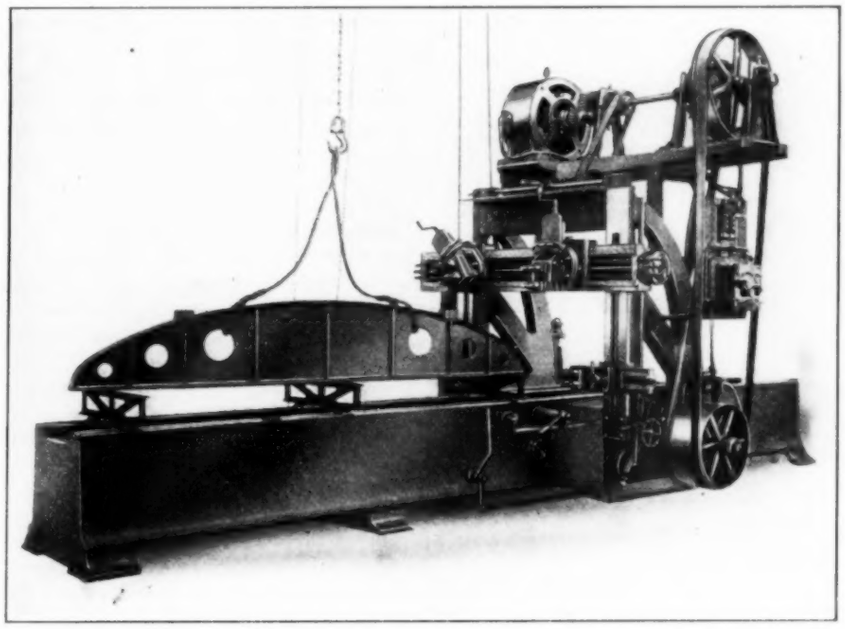
Arbor *A* and bushings *B* and *C* are made of tool steel, hardened and ground; the shaft *E* is made of cold-rolled steel and the hand wheels *F* and *G* and bush *H* of cast iron.

Leveling a Planer

By James N. Heald*

Having read with interest the article, at page 669 giving the experience and methods of others in alining planer beds, it has occurred to me that possibly a description of the method we employed for putting a recently installed planer in perfect condition would be of interest.

The accompanying photograph shows a new Woodward & Powell 36x48-inch by 14-foot planer, which rests on a solid concrete foundation 4 feet or more in depth and 24 feet long by 4½ feet wide. Firmly imbedded in the concrete under each foot is located a set of adjusting plates having a top surface 8x13 inches, which were planed and then located carefully by straight-edges in as nearly a level position as possible before the concrete was filled in around them.



LEVELING A PLANER

The planer was moved onto these plates and then leveled up in the usual manner with an accurate spirit level with parallels and rolls in the V-ways, as is customary. After we had been planing with this for a time, we found that the accuracy was not up to our requirements as the accuracy that grinding machinery requires we believe to be greater than that necessary in any other line of machine tools. We therefore decided to perfect the alinement of this bed and bring it to a greater degree of accuracy than we had been able to attain by the other methods.

The illustration shows quite plainly how this was accomplished. We used a 10-foot straight-edge of known accuracy in connection with three parallels, and three pairs of rolls in the V's. The parallels are all of uniform hight and the rolls ground accurately to a uniform diameter.

The first operation was to get the general alinement from end to end of the bed as nearly correct as possible, the leveling plates under each foot being adjusted when necessary to bring this to a straight line. The plates shown on the floor carelessly placed, are the cover plates for the openings containing the adjusting screws.

Occasionally during the lining up of the two sides of the bed the straight edge would be placed on the parallels diagonally across the bed, as shown when this photograph was taken. This served to take out all wind in the setting up so that we not only had the V's perfectly straight from end to end, but also were able so to adjust the front and rearways with reference to each other that there was no twist or wind whatever when the leveling and adjusting was finished.

With reference to the degree of accuracy obtained, we would say that we believe this to be an improvement over any method of leveling by the use of a spirit level which we have seen used. It was easily possible to adjust the bed at different points so that a piece of tissue paper would be pinched or released, either under the middle of the straight-edge or at either end, depending upon which point was being tested out at the moment, and as the tissue paper used was between 0.001 and 0.0015 inch thick, we believe that the accuracy of this method is superior to the usual methods referred to above. Certainly the work turned out since this was done has shown a marked improvement.

There are one or two other things about the planer which the illustration shows fairly well and which may be of interest. One is the location of the starting box, switches and cut-out on the board between the two sides of the open driving belt. This board is supported from the housing by suitable angle-iron supports and is quite out of the way and yet convenient to the operator.

The planer has two speeds for the cutting stroke controlled by the vertical lever shown near the right-hand end of the straight-edge, one of these forward speeds operating at 34 feet per minute and the other at 51 feet, the return speed being about 75 feet in either case.

This method of getting a variable speed puts the necessary gearing all in the bed where it seems to me there is less chance of giving vibration to the cutting tool, and in our experience has proved very satisfactory.

According to official statistics just published, there were on January 1, 1908, in the German empire 36,022 motor vehicles, of which 34,244 were passenger vehicles and 1778 were freight vehicles. This is an increase of about 33 per cent. during the year 1907.

*General manager, Heald Machine Company.

Machine-tool Design in an Engineering Course

Designs and Working Detail Drawings of Machine Tools and Accessories Are Made by the Students of the Worcester Polytechnic Institute

BY E. H. FISH*

In our endeavor to give the students at the Worcester Polytechnic Institute, a correct idea of drafting-room practice we devote about one-third of the time allotted to drawing to commercial work. The Washburn Shops of the Institute do commercial work and afford some necessary drafting and a good excuse for more that might be used if the shops were larger. Many of the drawings made by the students are subsequently used in the shops, so a fair chance is offered for comparison of student work with that done by professional draftsmen. Thus far the comparison is about even.

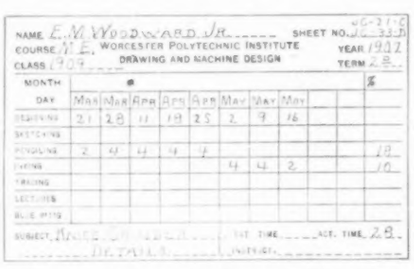
In this part of the work no two students are doing exactly the same thing except for a small part of the time. For the average student a simple machine is picked out of the number of things required by the shop and very general specifications given to the students. This year two have been used; one a special machine for centering both ends of a sensitive drill column at once, the other the details of a single-belt countershaft which was designed (?) by last year's class on lines so close to the well known Smith countershaft that we would not dare to build it without permission.

In designing points which are subject to calculation for strength they are figured out by the instructors for the students. There is no desire to anticipate the work in strength of materials which comes later in the course. The student is left free to design as he will on parts which require judgment or observation of usual practice. However, his attention is repeatedly called to conditions in his design which wholly preclude the putting of the thing together or getting it to pieces. Often we have to suggest that when a certain pin is driven into a hole a little gun powder should be poured in first so that it can be gotten out by heating. Often the most outrageously grotesque outlines of parts which merely fill air space call for a few words on the curve of beauty and the utility of straight lines. All the time we are sending students to the shop or to our catalog file to find out how others do it.

The work with these students is purely individual, no great results are expected and plenty of time is allowed for thought before help, other than an occasional question, is given. It is truly surprising how many curious ideas are unearthed and also how well the boys do, when thrown so much on their own resources. I overheard a junior giving a sophomore some tips just before the last term began. He said "When you strike Fish and Davis they will set you to designing something you never heard of before, but you might just as well go right ahead and design it first as last." It is just about so. They can get all the help they want as soon as they show that they have honestly tried to find out for themselves, and very little before. As a result we really have to help very little.

The men in the class who have shown signs of decided ability are given distinct jobs, but are treated in just the same way as the others. Sometimes we have to let several men in different divisions work on the machines during different years before we get what we want. This is the third year that we have had men on a design for a geared headstock for a 14-inch lathe. This shows, of course, that we do not do the designing for the students. We simply turn down their schemes one by one until we have passed their limit of patience, which is not very high, and then we let them finish up the best thing they have offered. All this takes considerable patience on our part as well as theirs, but we feel that they should learn what we did not learn until after we graduated from school. It pays better to experiment on paper than in hard iron and steel.

Students get a false idea in the course of their student life which is hard to eradicate while they are still in our hands, that is, that they should be told whether they are right or not at every step of a problem or design. Many is the kick I have heard because I let a fellow go ahead and hang himself with his own rope before I told him to back up and begin over.


NAME E. M. Woodward Jr. SHEET NO. JG-21-C
COURSE M. E. WORCESTER POLYTECHNIC INSTITUTE YEAR 1907
CLASS 1907 DRAWING AND MACHINE DESIGN TERM 2B

MONTH											%
DAY	Mar	Mar	Apr	Apr	Apr	May	May	May			
DESIGNING	21	28	11	19	25	2	9	16			
SKETCHING											
PENCILING	2	4	4	4	2						16
INKING						4	4	2			10
TRACING											
SECTIONS											
BLUE PRINTS											

SUBJECT Knife Grinder 1ST TIME AGE TIME 28
DETAILS CONTENTS

FIG. 1. FACE OF A SPECIMEN TIME CARD

TO Woodward E. M.
MAKE DRAWING NO. JG-21-C & JG-33D
FOR Knife Grinder
Details
NAME OF PART

FIG. 2. BACK OF A SPECIMEN TIME CARD

Machines Designed during the Last Two Years

Your readers may be able to judge of the variety of work handled in this way if I say that in the last two years we have gotten out the necessary drawings for an 8x40-inch plain grinder for cylindrical work, two styles of multiple-spindle drills, a knife grinder, several follower rests for lathes, the special centering machine referred to, a laboratory-testing machine, an arbor press, an 18-inch high-speed lathe, a lathe turret, a revolving chuck for a turret lathe, two single-belt countershafts, a boring mill and a cold saw. Of course, it will be understood that a considerable amount of experience with the design of such machinery in commercial shops is necessary in order that an instructor may qualify to look after such work. In one afternoon a class of 30 boys turned out 30 sheets of details, complete with title, index numbers, etc., for a 14-inch Prentice geared lathe head, averaging two pieces to a sheet. They were all made in 3¾ hours from one blueprint, were completely inked and with very few errors. Only one boy out of the class had ever seen the blueprint or the castings before; none had seen a completed headstock, so it will be seen that they had to study out their separate pieces entirely from the drawing as well as to draw them. The drawing from which they worked was a dimensioned assembly drawing.

The Drawing-room System

In order to get out this work without hitches and misunderstanding a certain amount of system is not only necessary but desirable, so that the students may become accustomed to adapting themselves to a system. First, we have to number the drawings; we accommodate our system of numbering to that already in use in the Washburn shops. The shops assign to each machine built a letter for a symbol. We wish to assign a definite symbol to every machine on which even a detail is drawn. Inasmuch as we do many odds and ends of jobs that are not referred to above, our list of symbols required during the first year outran the alphabet. If the shops take on any of our designs it might not be convenient for them to adopt our symbol, even if it

*Instructor in mechanical engineering, Worcester Polytechnic Institute.

is a single letter, as they wish to use the letters in succession.

We use two letters to a machine, the first of the two is the same for a group of machines having some similarity; for example, *A* group comprises all machine tools in which the work revolves and the cutting tool is stationary except for its feeding motion, *A B* is a single machine, an 18-inch high-speed lathe, *A C* is a geared headstock for a 14-inch lathe, *A D* is a 22-inch Draper lathe or any attachment for it, *A E* is a boring mill, etc. As often as a different machine of this class is worked on a new tab card is made out and placed in our card index of completed drawings. The other groups as we use them are:

B. Drilling and milling machines and all tools in which the cutters revolve. This section so far includes the drilling machines referred to and a 16-inch heavy drill press on which the experiments of Professors Bird and Fairfield on the efficiency of drills were performed.

C. Planers and shapers and all other reciprocating machinery. Strangely enough we have rolling mills under this class, but then the work reciprocates in that case too.

D. Small tools, drafting room or toolroom equipment.

E. Shafting and power-transmission machinery, such as the countershafts referred to.

F. Engines, boilers and other power generators.

G. Supplies. The only thing we have under this head is a steam trap and a power shaker for a sieve for the foundry.

H. Hoisting machinery.

I. Fastenings. This letter is retained only because we use this classification for a catalog index which we use in this work. We do not make drawings of standard bolts, nuts, etc., for themselves alone.

J. Grinders of all kinds. These might have been indexed under *A*, *B* and *C*, but we preferred to make a separate section since they are alike in one respect at least.

K. Electrical machinery.

L. Testing machines.

It will be seen that we have a comprehensive classification and yet have room in the alphabet for more. Some of these, like power generators *F* and electrical machinery *K*, would have to be divided into a number of groups were it not for the fact that we leave these two subjects for the departments which teach those lines. We try not to repeat work with students.

Each student is given a time card, Fig. 1, 3x5 inches standard, with spaces, as shown, for filling in the time spent on any job. A separate time card is used for every job, though not necessarily for every sheet. On the back of his time card, Fig. 2, is stamped his order, and is filled in with the student's name, the symbol of the machine on which he is working, the size of sheet on which he is to work and the serial number of the drawing. For example, *B D*—121—*C* signifies that the drawing is of some part of the special machine for centering drill posts, and is to be the 121st sheet ordered made of the *C*-size (12x18 inches). That is, 120 *C*-size sheets have been ordered, not of this one size of machine, but of all machines. A successive list is kept in a notebook in which each drawing is set down in order when ordered, so that two drawings will not be ordered of the same number.

In addition to issuing to each student this time card a duplicate of the back, Fig. 2, is kept by the instructor on a separate card which he puts in the file with others with the students' names in alphabetical order, so that it is easy to find what work has been assigned to any student. As soon as a student has completed his assigned job and turned in his time card, this duplicate order card is taken from its place and dropped into a compartment marked "finished drawings." Later, when the student's work is examined it bears the percentage mark or grade of the drawing. Thus at all times, and with very little work we have a record of what is being done, and what has been done by every student filed under his name, also a record of what has been done on every machine.

Part No.	Name	Material	No. Req.
1	Swivel	Cast Iron	1
2	Carriage	Cast Iron	1
3	Saddle	Cast Iron	1
4	Bed	Cast Iron	1
5	Feed Screw	Mach. Steel	1
6	Feed Screw Sleeve	Cast Iron	1
7	Hand Wheel Feed	Cast Iron	1
8	Nut-Feed Screw	Cast Iron	1
9	Worm Shaft	Mach. Steel	1
10	Worm	Cast Iron	1

FIG. 4. TABLE OF PARTS FOR A DETAIL SHEET

Number of Part	J C Name of Part	Number of Drawing	Material	Weight of Stock	Number Wanted	Stock: Size	Stock: Length	Deliver to for First Operations	Machines on which a Duplicate is used
1	Swivel	20 C	C.I.		1			Planer	
2	Carriage	20 C	C.I.		1			"	
3	Saddle	21 C	C.I.		1			"	
4	Bed	32-D	C.I.		1			"	
5	Feed Screw	31 D	Mch S.		1	7/16	61/4	Lathe	
6	Feed Screw Sleeve	31 D	C.I.		1			C.Lathe	
7	Hand Wheel, Feed	33 D	C.I.		1			"	
8	Nut, Feed Screw	32 D	C.I.		1			"	
9	Worm Shaft	21 C	Mch S.		1	5/8	11	Lathe	
10	Worm	33 D	C.I.		1			"	
11	Rack	33 D	C.I.		1			Planer	
12	Gib, Carriage	21 C	C.I.		1			"	
13	Gib, Screws	31 D	Mch S.		3	5/16	1 1/2	T.Lathe	
14	Hand Wheel, Nut							Buy	
15	Swivel Binder							Lathe	
16	Gib, Saddle	32 D	C.I.		1			Planer	
17	Nut, Swivel Binder	31 D	Mch S.		1	1	28 3/4	Buy	
18	Saddle Gib Screws	32 D	Mch S.		1	1/2	1 1/4	T.Lathe	

FIG. 3. RECORD OF MACHINE PARTS

Worcester Polytechnic Institute

With classes of not over 40 for two instructors we do not need any record of what work has been assigned, arranged according to machines. To do this would require an additional card for each job which would be bothersome and would hardly pay. Students working on the design of a complete machine or an attachment consisting of a number of parts are required to name the parts, number them and fill out a blank, Fig. 3. This gives us the number of the part, which consists of the machine symbol and a number which is assigned by the student beginning at one for each machine. Then comes the name of the part which calls for considerable ingenuity to get a name which shall be descriptive and yet not too long. Then comes a column for the number of the drawing on which the detail is to be found, or, if there is to be no detail, the number of the assembly drawing on which it is best shown, then a column for the material, which is also shown on the sheet, as is also the number wanted per machine. A column is left for the weight of the stock to be used in computing costs. Two columns are left for the size and length of stock. These are filled in only for bar stock for the benefit of the man at the cutting-off machine. The next column shows the kind of machine tool to which the casting or stock should be sent for the first operation, and is followed by a column in which is placed a reference to any other machine which uses the same part.

The sheets on which details are drawn also carry, Fig. 4, a table of the parts detailed on that sheet, their numbers, material and the number wanted.

Results

The results of this work which I have been slowly developing in the past five years show more in increased thinking capacity and increased care for smaller points than in show drawings. Special endeavor is made in other parts of their work over the drawing board to get clean cut, carefully-inked drawings; in this particular part of the work practicability of manufacture is the main thing. In this way it goes hand in hand with the shop instruction and we have to be very careful to see that the boys know that there is more than one way to do every job, and that we do not pretend to know just how they would be taught to do any particular job in the shop. So far we have been able to get along with very little friction and we believe with a broadening effect on the students.

Novel Construction in Oil Engines for Small Powers

By A. S. Ager

The writer has come across an interesting variation from standard practice in constructing oil engines for small power and high velocity, which may be of interest to other engineers on account of the cheapness and simplicity of construction. The arrangement is not so far as he is aware the subject of any patent, but possesses considerable ingenuity.

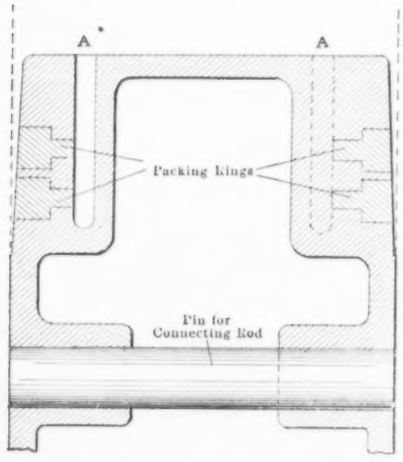


FIG. 1. PISTON AND RINGS

Taking first the piston, Fig. 1 explains pretty clearly the construction of the same. In place of the usual spring rings which are liable to become inoperative due to the failure or weakening of the springs under exceedingly high temperatures, the piston is fitted with a double row of packing rings of a T section, as shown. These fit fairly accurately into the grooves. The back end of the T emerges on to a series of holes *A* drilled into the piston from its end around a circumferential ring. Each packing ring is cut into three equal pieces and the joints are lapped so that there is no direct through passage. On the explosion of the gas the pressure passes down the bore holes at the back of the packing rings, pressing them out against the cylinder walls. This arrangement gives a maximum of pressure at the point of the greatest shock and is therefore a very good means of keeping the cylinder gas tight. The only trouble experienced is that the

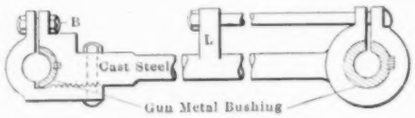


FIG. 2. CONNECTING RINGS

cylinder lining gets worn toward the back end, corresponding to the position of the piston rings when the explosion takes place.

In order to allow for the effects of expansion on the piston, which is greatest at points nearest to the hot gases, the piston is tapered slightly toward the head. For fixing to the connecting rod a pin of mild steel is passed through the piston, which is made of malleable cast iron.

Coming next to the connecting rod, we have the point to remember that it may be necessary to adjust the connecting-rod end when the piston is buried some distance in the outside casing of the engine, and there is therefore forged on to the rod a lug *L* through which a long bolt is fitted which is prevented from turning by filing a flat on the head next to the connecting-rod end. The slight tendency toward bending the connecting rod by side leverage is corrected by means of stiffening the rod beyond its usual limit for direct thrust. A split gun-metal bush is placed in the interior of the connecting-rod end and held in position by means of a feather key. The crank end of the connecting-rod also presents a useful form of structure as will be seen from the sketch. To the cast-steel end of the connecting rod is bolted a gun-metal strap of the shape shown, and this together with the connecting-rod end is provided with serrations so arranged that they fit one into the other. The hole for the bolt passing the connecting rod is made slightly oval to allow of a little displacement. As the wear on the crank end is in one direction only a half bush of gun-metal is provided.

Should there be any necessity to take up wear a movement along the distance of one serration, combined with a certain amount of tightening on the bolt *B* is sufficient to give all the adjustment necessary. As a matter of fact the fit on the crank end should be fairly loose. The whole structure is one of an exceedingly light nature and very simply put together and should be of use in light oil-engine work.

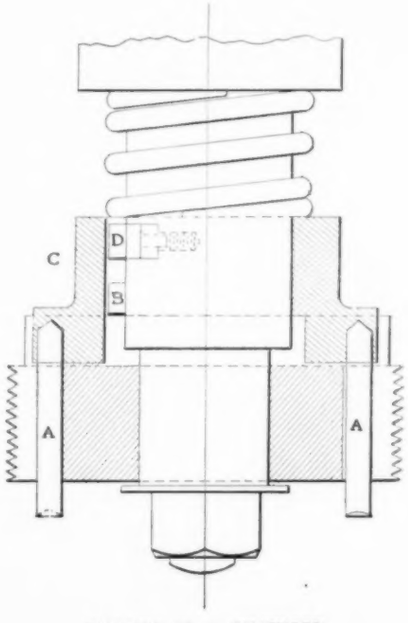
Tapping to a Shoulder with an Automatic Tap

By Oscar Johnson

The accompanying sketch illustrates an automatic tap, which was made to tap to a shoulder in the turret lathe. We have always used solid taps for the purpose, but on account of jamming the taps up to the shoulder and breaking them, or shearing the pin which keeps the tap from turning, we decided to make something to remedy that trouble that would require no delicate setting.

In the drawing, the pins *A*, which extend through the flutes of the tap, strike the shoulder first as the tap is fed in; and as the tap continues to feed, the pins push the collar *c* off the key *B*. As can be seen, the collar has two lugs on the end, which fit in a slot cut in the end of the tap, the pins push the collar far enough to clear the key *B*, but the lugs are never clear of the slots, and the top and collar revolve with the work.

The pawl *D* is forced down as the collar revolves with the work on account of the back side being tapered, but as soon as the lathe is reversed the pawl catches in the keyway and the tap backs out.



TAPPING TO A SHOULDER

The spring pushes the collar back to its original position, so the tap will feed to any depth before tripping.

Here are some interesting figures in connection with the famous Krupp works: During the year 1906 the combined works consumed 2,361,425 tons of coal; there are on the payroll 65,000 men; in the Essen works there are 6500 machine tools in use; 74 hydraulic presses, over 300 stationary steam boilers, and considerably more than 700 cranes.

Some Methods and Tools Used in a Shaper Shop

Testing Shaper and Other Parts with a Dial Test Indicator and Scraping and Milling Surfaces with Special Fixtures

BY N. B. CHACE*

The half-tones illustrate some special tools and methods employed at the shops of the Cincinnati Shaper Company, Cincinnati, Ohio.

Scraping a Taper Gage for Planer Work

In Fig. 1 is shown simple means of finishing by scraping a taper gage, using the dial-test indicator to obtain the right hight and the proper taper. The gage shown is to be ⅛ inch taper to the foot, and is tested by passing it under the spindle of the indicator, limiting its travel by means of blocks placed at either end of the surface plate just 12 inches farther apart than the length of the gage. The spacing of the stop blocks can be obtained by simply using a 12-inch scale in conjunction with the gage to be scraped. Should the gage to be scraped be shorter than 12 inches, a 6-inch scale can be used.

The gage is kept true in its travel under the spindle of the indicator by means of a straight-edge shown at the rear. This gage is to be used on planer work for getting the width of the opening as well as the proper taper to be planed in the piece.

A Vise-testing Fixture

The fixture in Fig. 2 is used for testing vises. The large surface plate has slots running at right angles to one another across its face, in which the tongues on the vise bases fit. By means of the test indicator held at the end of the slide any error can readily be found by running the indicator over the vertical and horizontal surfaces. This jig is also used to square the vise when placing the pointer for the graduated base. It is needless to say that it was an easy matter to construct this jig to make the ram travel parallel to the surface plates, inasmuch as the test indicator was used, as shown in the illustration, with the spindle bearing on the surface plate.

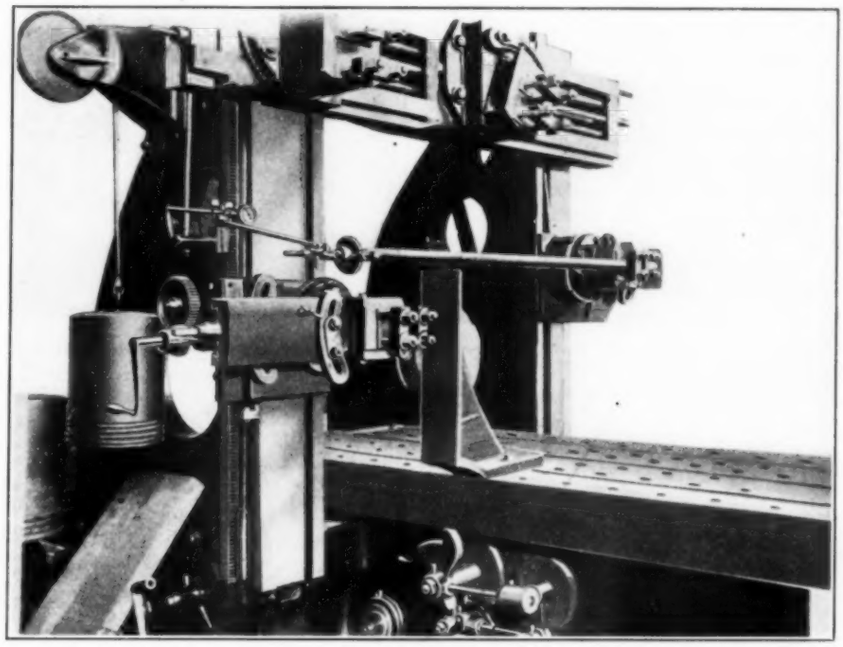


FIG. 4. TESTING PLANER HEADS

Inspecting a Shaper Column

Fig. 3 shows a method of inspecting a shaper column. For this inspection a special square is used and also a tram

*Superintendent of the Cincinnati Shaper Company.

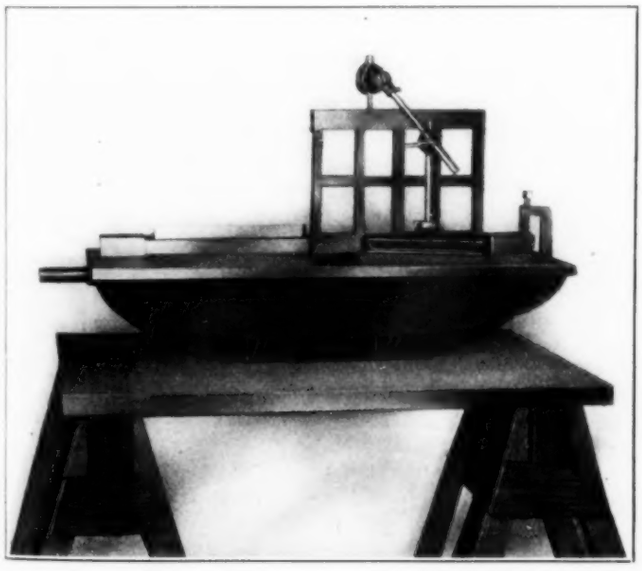


FIG. 1. TESTING A TAPER GAGE FOR PLANER WORK

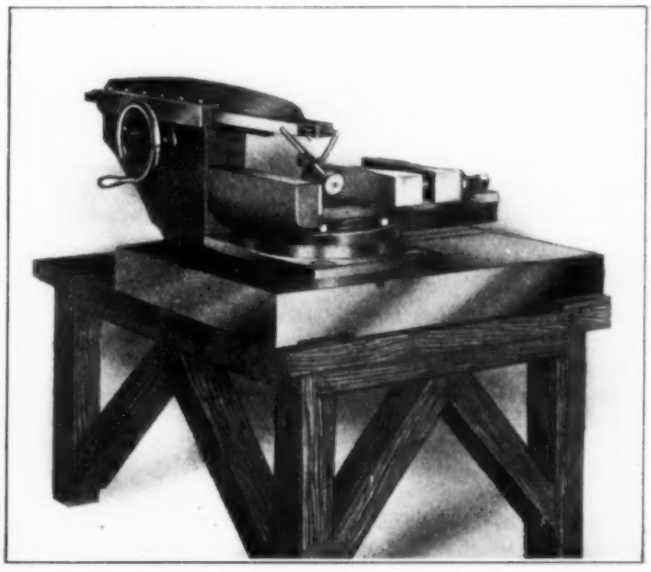


FIG. 2. TESTING A SHAPER VISE

with the dial-test indicator attached to the arm. The arm of the tram is swung across the face of the column and the indicator registers the error.

The body of the tram is held against the ram bearing opposite the gib side by means of long jack-screws with ball-bearing heads. It is essential that these thrust screws or jacks have ball-bearing ends, as a plain head distorts the tram body. The method of inspection with the special square is self-evident and needs no explanation.

Testing Planer Side Heads

In Fig. 4 is shown a test being made on a planer for side-head accuracy. In the right-hand side head is clamped a bar that is long enough to reach to the other side of the planer, and on the end of this bar is fastened the dial-test indicator by means of a lathe dog. The indicator bears on the outer edge of the left-hand housing. In the left-hand side head is clamped another indicator which bears on a tested angle plate, which is resting on the table. After the test is made the bar in the right-hand side head is shortened and its indicator is brought to bear on the

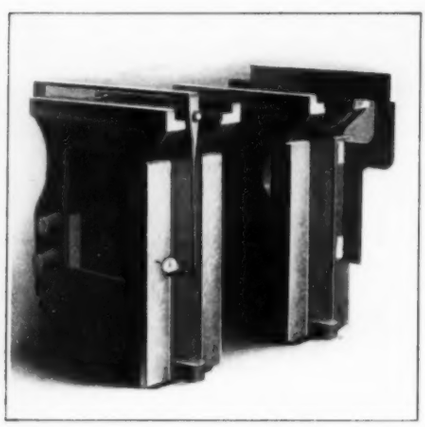


FIG. 3. TESTING A SHAPER COLUMN

angle plate. Then the angle plate is turned one-quarter way round and another test is made on its face by both heads to see if there is any wind in the housing faces.

Another test is made with the indicator in the left-hand side head bearing on the end of the bar in the right-hand side head, both heads traveling together.

Locating a Fixture on the Miller

Fig. 5 illustrates a method of using the dial-test indicator to find any error there may be in the location of a fixture placed on a milling-machine table. The face of this fixture is placed so that vertically it is at right angles to the axis of the milling-machine spindle, but horizontally it is bent at an angle that would give pieces clamped on its face ⅛ inch taper to the foot. The spindle of the indicator is placed 6 inches from the center of the milling-machine spindle, and the latter given one-half turn to show if the setting is correct.

A Turret-lathe Test

An easy way of testing the truth of a turret hole and the slide of a turret lathe

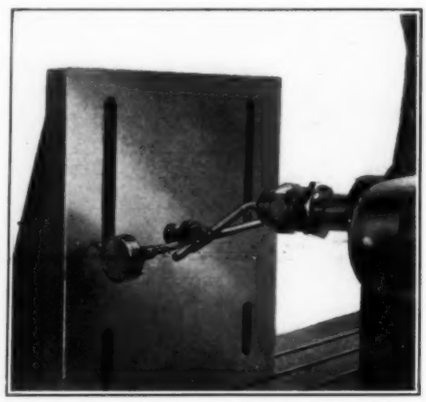


FIG. 5. LOCATING A FIXTURE ON THE MILLING-MACHINE TABLE

by using the dial indicator is shown in Fig. 6. It is evident that when the indicator is held as shown, the truth of the turret hole and the turret slide can be tested by simply revolving the indicator around the ground bar held in the turret and by sliding the bar under the spindle of the indicator, by means of the turret slide.

A Gear-cutter Test

Fig. 7 shows a very simple way of testing the truth of the grinding on the sides of a gear cutter in relation to the formed portion. Clamp a square on the surface plate and revolve the cutter backward under the spindle of the dial-test indicator, letting the spindle of the indicator bear on the formed portion of the cutter and holding the cutter against the stock and blade of the square to bring the teeth of the cutter in the same position each time. This test could not be made satisfactorily by putting the cutter on a mandrel and revolving it, if the cutter runs out on its periphery. For the sake of better illustration, the spindle of the indicator is shown bearing on the cutter at a point bearing diametrically opposite to where it should be when testing the cutter. Quite a few gear cutters are ground so they wabble and in cutting accurate gears it is best to look out for this defect.

Fig. 8 shows a fixture driven by a motor, and used for milling the surface on the shaper base that the table support slides on. The jig is bolted to the apron of the shaper and is automatically fed across the base, the motor furnishing the power for milling, which is transmitted through knuckle-jointed shafts. The flat rod coupled between the truck and the fixture rolls the truck on the floor, making the power follow the work. By means of this device the milled surface on the base is made absolutely true with the line of shaper travel.

In Fig. 9 is shown a motor-driven device used when scraping the column, clamps and taper gibs to the ram after

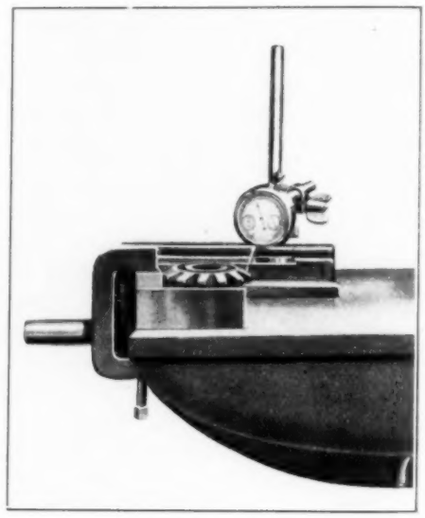


FIG. 7. TESTING A GEAR CUTTER

the latter has been scraped true to the surface plates and straight-edge. This motor-driven arrangement is clamped to the face of the column, and when in oper-

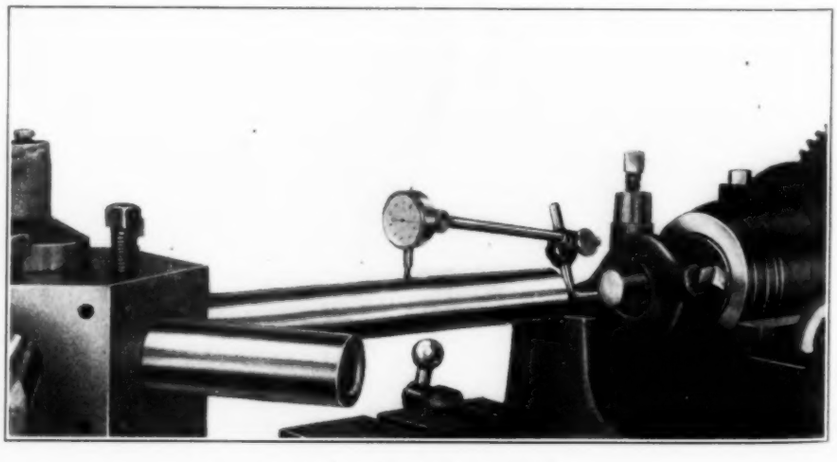


FIG. 6. A TURRET-LATHE TEST

ation, moves the ram back and forth in the column. The rocker arm, which actuates the ram, has a variable length of stroke and is slotted in the top end to enable one to take the ram out of the column without removing any of the mechanism. The device may be adapted to all sizes and kinds of shapers by attaching different shaped pieces to the ram head.

Some Vicissitudes of the Job Shop

By J. G. Dornbirer

Nearly every mechanical genius has "monkeyed" with a perpetual-motion apparatus, if you please. Ignorance of the law of the conservation of energy has made more good mechanics than a thorough knowledge of it. Some may dispute this; I claim it only through personal observation. I did not make this statement with the intention of encouraging ignorance; the statement seems paradoxical; I may be wrong, perhaps I am.

Now, since all the variations from the positive to the negative side of the above statement have been acknowledged, no one needs to get "all riled up" about it. The ability to disassemble and reassemble any machine in a machine shop without standing and scratching all the dandruff off your head is more valuable than being able to differentiate the curve of the lunar orbit.

One day a boy of about 18 years of age drove up to the shop and unloaded about two tons of castings. He brought also a remarkably good set of drawings, none of which, however, showed the machine assembled; and he firmly resented being interviewed regarding his machine. Some of the work had been done, such as a small lathe could handle, and it was of an exceptionally good quality; in fact it was done so nicely that we knew at a glance that our competitor did not do it.

We did the work as ordered and were promptly paid for it.

In a few weeks we had some alterations and new attachments. We couldn't even find out by ordinary means where the inventor lived or where he came from. He never kicked on the price and we thought we had a good permanent customer. One day he came with a job and wanted it done in a hurry. The man who usually ran the lathe was absent; the rest were very busy. He told the boss that he could do the job if he could use the lathe. The boss told him to go ahead. The job in question was very difficult so we expected to see him up against it. But, say, the way he handled that job had our man "struck to the skillet."

The boss tried hard to find out where this young genius came from, but to no purpose.

One day the boss started out on one of his collecting expeditions to replenish his depleted treasury. In passing a barn, which was in a lot adjoining the road, he heard a noise that sounded as though domestic difficulties were being adjusted in no uncertain terms. He ventured to peek through a crack. He saw an elderly couple and our young customer, who turned out to be their son. "Now John," said the old gent, "you can't have another darn cent; you have got the farm all used up; we even sold the horse and buggy and every cent is in that darned infernal machine. Besides you hain't earned a cent in months and we are getting old. You must git a going and earn something to help us." The old lady was weeping and the boy was pleading like a dope fiend for "just one more" chance.

The boss decided to go in and see what was being constructed and to see if he could be of any assistance. At first he was treated in a very cool way; but finally the old gent blurted out, "stranger, what do you know about this kind of machine?" Then it was explained as a generator of perpetual motion. The boss stated that so far as was known there was no exception to the law of the conservation of energy. He invited the young man to come to his home and look up the different authorities on that subject, and showed on the machine why such a thing was impossible. At first the boy seemed to doubt, but finally he agreed to investigate. His parents were furious to think that they gave their money to such a visionary purpose, and upbraided the boy.

After they had had their say, he spoke thus: "Father, what has this cost you?" The old gent figured a while and said he "reckoned about $2200." The boy thought he might get about $50 for the machine as junk; the lathe, shaper, drill, engine and band saw, with a lot of small tools, etc., might bring $700, since they were nearly as good as new. That would leave him in their debt about $1500.

Through this experience the young man had certainly gained a whole "woodshedful" of knowledge and practice. He was the son of a farmer and had lived all but one year of his life on the farm. His library consisted of a few catalogs of machine-tool builders, about 25 copies of a well-known mechanical journal and an encyclopedia of applied mechanics. He had made his own drawings, patterns and forgings, and had learned to operate tools, run a steam engine and various other things. The boss thought that it was the best value $1500 ever purchased.

The boy came to work in our shop, and proved so eminently successful that within a year he had charge of it. His mind was always in a clear receptive condition, a condition too often underestimated by most boys nowadays. He also knew something of business. Most boys of his age are guilty of buying very little except peanuts and flaming lemonade, if nothing worse. I have frequently caught boys in our employ with the perpetual-motion bee humming under their "lids;" invariably they became exceptionally good and ingenious mechanics.

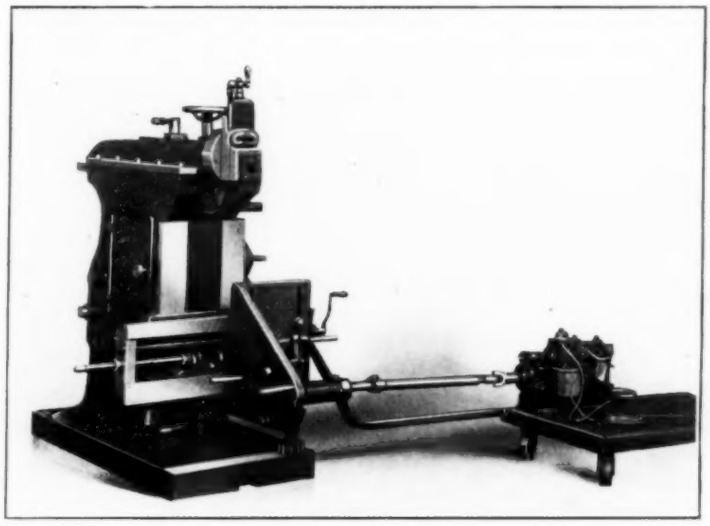


FIG. 8. MOTOR-DRIVEN MILLING FIXTURE

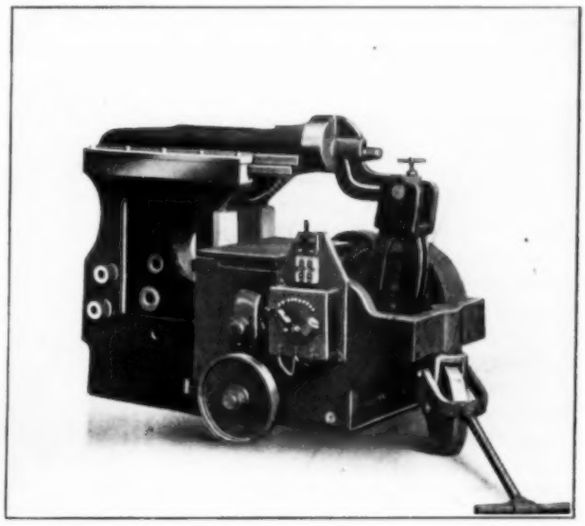


FIG. 9. MOTOR-DRIVEN SCRAPING FIXTURE

Hand Turning Operations in the Lathe

Machining Pulleys, Facing Gear Rims and Hubs and Performing Numerous Other Operations in the Hand Lathe with Simple Tools

BY JAMES LOMAS*

In the production of metal parts of circular and other forms required in the construction of various descriptions of machines, many mechanical processes and systems of production have become so specialized that the employment of older and simpler methods has almost ceased, and the possibilities of many handicrafts with unlimited good points to their credit are practically abandoned. Yet some of these old and simple systems can be profitably employed today, even when working in competition against tools of modern design and construction.

Of these neglected crafts, perhaps none is so noteworthy as the use of hand tools in the lathe, or as it is usually termed, hand-turning. And to no country does this refer with greater force than America, where it is practically non-existent.

Pioneer Machine Work

Twenty-five to fifty years ago, in the pioneer days of machine construction, and when Great Britain stood almost alone in the making of machine tools and textile machinery, the hand-turning tools were considered quite as necessary an adjunct in the production of the parts of such machines, as the slide, or engine lathe, and in almost every works producing this class of machinery they were used to advantage and there are still plenty of these machines and machine tools in existence, and doing good work in our best engineering shops and textile mills. Illustrative of this I make mention of such a machine tool being in use at a recent machinery exhibition held at Olympia, London, demonstrating the use of the modern "A W" high-speed steel, thus giving proof of the quality of work done in those bygone days when hand-tool work was common. Especially are hand tools economical when the parts required are in small, or medium quantities and where there is considerable variety of work to be done; the work most suitable being articles of short length in cast and wrought iron, steel and other metals.

Simplicity of the Hand Lathe

It must not be supposed that these are the only jobs that can be done by hand tools, as I can testify, having done on many occasions such work as engine crossheads, crank throws and similar work. The hand tools are also of considerable advantage for executing much work that, if done by the engine lathe would require special and frequently costly fixtures and rigs, whereas the hand lathe will invariably meet the difficulty with a few simple tools only and oft-times emergency jobs can be done, such as truing articles in position after a machine is started up. In truing up the teeth of cast, spur, and bevel wheels, articles which are extensively used in cotton machinery, I have seen no better and quicker method than that shown in Fig. 1, which consists of simply holding a file tang downward and wedged between the rest and face of the wheel cogs, the wheel rotating at a moderate speed, according to diameter. It is only the work of a moment to change from face to side of teeth and when the side is finished to move the rest again to the wheel boss and turn it by hand, then finish and polish the boss.

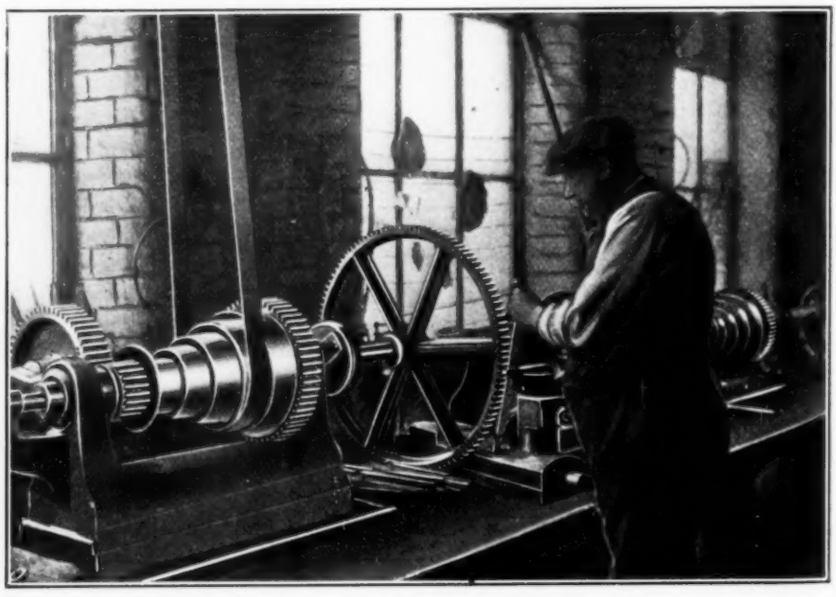


FIG. 1. TRUING A GEAR IN THE HAND LATHE

To do the same job with the engine lathe would necessitate a special tool held in the slide rest to hold the file for face and side of tooth, then a change to tools for turning the wheel boss, and by the time the job was complete, the hand turner would probably have finished half a dozen and made a much better job of them, besides saving in the cost of tools required, and with much less risk of tooth breakage.

Rapidity of Operations

As every lathe hand well knows the time lost in changing the tools in the engine lathe is a great drawback, and loss of time in manipulating the lathe, has led to many improvements and special appliances both of a simple and costly nature. But even with the best of these, time is taken up in changing the tools. True, there is the turret rest, but these are usually so arranged as to be of very little use in many cases. In taking the case quoted, the expert hand turner will fix his rest and use every tool required to finish the job without any further trouble than laying down one tool and taking up another until the job is done.

When a job is fixed between the centers of the lathe, the hand-turner has no obstructions before him and can therefore see his work perfectly and more readily deal with it, and it thus becomes very little trouble for him to use his scraper in finishing cast iron. This tool is little used by the engine-lathe hand, because of the inconvenience when using this type of lathe. Thus the hand turner has the advantage of being able to finish his work much better, and it is a notable feature of machines where hand-tool work is in vogue, that there is more polished work on the turned parts. In textile machinery this polishing is a very important matter inasmuch as all the particles of fiber floating about adhere to the machinery, and in polished work this is easily cleaned, whereas if parts are left unpolished, the fluffy matter becomes a nuisance.

*Manchester, England.

The Home of the Hand Lathe

In England, the hand lathe is most frequently met with in Lancashire and Yorkshire in the districts where cotton and wool machinery is manufactured, and experience has proved conclusively that there is still plenty of room for the hand lathe.

And it need not be thought for one moment that modern machine tools have been overlooked or insufficiently tried. As operator, manager and salesman I am as conversant with modern tools as with ancient and am acquainted with English, American and Continental makes. Among the makers of the machinery mentioned in the foregoing paragraph may be found some of the most astute engineers in the world, who have almost a monopoly of the world's trade in their line. They are business men who would not permit laxity of management, or high cost of production; they are always on the lookout for improved methods of production, and a reduction of their present costs, and are ever ready to adopt any new machines, or tools that permit of better results being attained. And yet it is principally in these works where hand lathes and hand tools are still in use, simply because they form the best and cheapest method of production of the work required. An instance of the failure of the modern lathe to produce work as cheaply as by hand turning may be quoted:

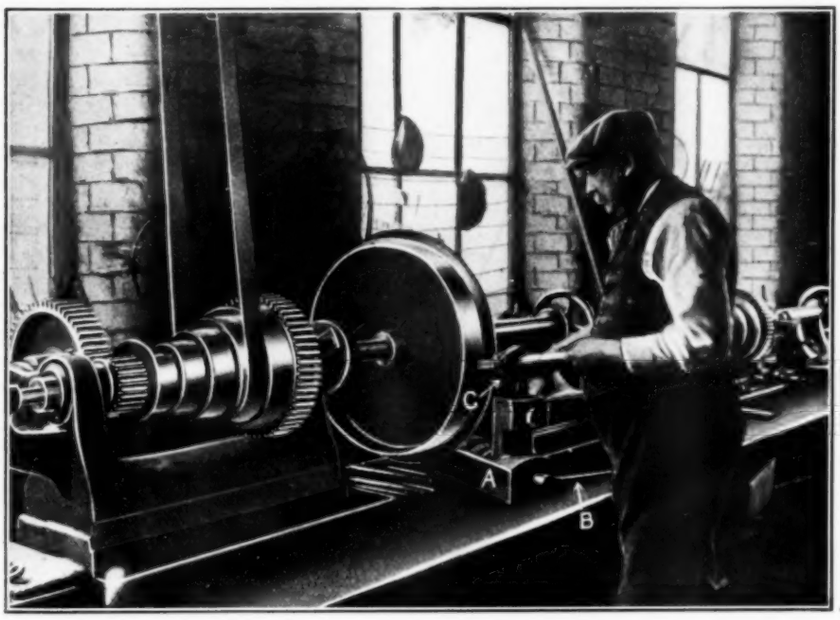


FIG. 2. A PULLEY TURNING OPERATION

Hand Turning vs. Turret Lathe Operation

The management of one of the largest textile machine works in the world was approached with respect to the suitability of a well known American chucking and turning combination lathe for its work, and the firm being ever ready to adopt improved machines readily expressed its desire and showed its willingness to consider the suggestion, and invited the representative of the American firm to visit the textile works and select from an abnormal stock and variety of castings such as were specially suited to the lathe in question. These castings were sent to the lathemakers and duly finished. Time was taken and results compared with the costs of exactly similar work produced by the older methods, and the advantage in favor of the hand turning was so pronounced as to be almost incredible and would have been doubted in the absence of comparative data.

Another instance of a more recent date was given me where a capstan lathe was installed for making studs, etc. This particular machine was placed in a works where the manager was of the opinion that the time was at hand when hand-tool work could be superseded and the cost of production materially reduced, and he was determined that the newer method should have a fair trial. He accordingly watched matters very closely, and yet after a prolonged trial he candidly admitted to me that except in cases where large quantities of one pattern were required, he found the hand turning distinctly cheaper. And when the cost of special tools requisite for the capstan lathe was taken into consideration, the advantage was with the old method.

The Workman Selects His Tools

In most cases among this class of work piecework rates are fixed and the operator is therefore allowed considerable latitude regarding the methods and tools used. While acting in the capacity of manager I have frequently seen special tools and appliances discarded by such workmen and hand tools of a simple nature substituted in order to obtain a larger production. In other instances it has been necessary for me to organize piecework systems for hand-tool work similar to that done with engine lathes, and in many cases the prices fixed have been less than when the engine lathe is used. This is particularly so with such work as handles, knobs, special pins, bushes and even more so in articles with curves, fillets, etc., for the dexterity with which a good operator can use hand tools on such work is astounding and truly amazing to those who know little or nothing about hand-tool work.

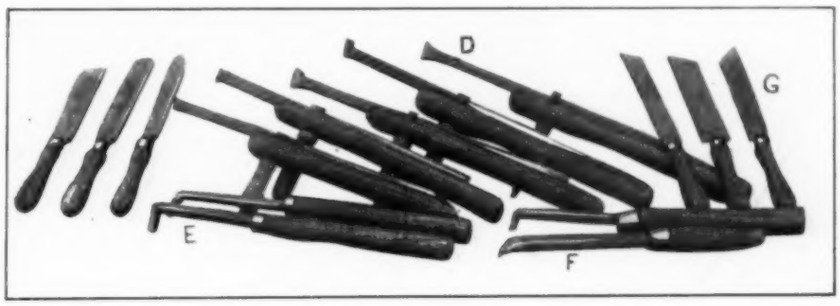


FIG. 3. SOME TYPICAL HAND TURNING TOOLS

The Hand Lathe in the Tool Room and Job Shop

As a tool-room machine the hand lathe is as valuable as any other part of the equipment, and if a modern hand lathe was made with hollow spindle a threading head and other modern points attended to with chucks, twist drills and other requisites in the equipment, leaving out the costly V-bed and usual automatic carriage, guide screw, etc., substituting hand tools and an ordinary compound rest, it would be a much more valuable tool and one having a wider range of purpose than many other tools. I do not say discard the screw-cutting lathe, but I do say that a tool such as described would serve a better purpose than many ordinary tool-room lathes. As a tool also for the jobbing shop it has even a wider range, for the usual jobbing shop has much of a make-shift nature about it, and does a great variety of work, entailing special rigs made cheaply to avoid excessive cost. This is where the utility of the hand lathe comes in. A

lathe for this purpose should have an extra long bed, up to 30 feet, so that two or three pairs of heads can be used if necessary, and in case of a shaft coming to be straightened the lathe bed can be stripped to one pair of headstocks. A lathe of this type can also be used for cylinder boring and many other purposes, and is a cheap tool compared to the ordinary lathe. In fact, no jobbing shop is complete without one, for if well equipped with the necessary appliances the hand lathe for jobbing purposes is equal to two ordinary slide lathes, at a minimum cost.

The Hand-lathe Equipment

The hand lathe at present in use throughout Lancashire and district, is such as is shown in Fig. 2, and consists of a back-geared fast headstock of from 10- to 14-inch centers, (20- to 28-inch swing), a loose head of same centers, a rest bracket *A* with a handle *B*, which secures the rest bracket to the lathe bed with an eccentric bush and clamp, several rests like *C* (which the hand tools operate on) of various patterns to suit different kinds of work. A compound rest also forms a useful accessory. A number of tools are shown in Fig. 3; these are not a complete set but merely serve to show the type of tool used. *D* is a hook tool; *E* a side or L tool; *F* is a heel tool and at *G* are several scrapers. The number

FIG. 4. A GROUP OF HAND LATHES

and forms of tools are almost unlimited as they are made as required for the work in hand. Often special and unique shapes are required. Fig. 2 shows the writer turning by hand a 28-inch single-flanged pulley. Fig. 4 shows a number of boys at work using hand tools. It will be noticed in this picture that the lathes have no striking or belt-shifting gear; merely a variable-speed pulley on the main driving shaft of the same pattern as that fixed on the fast headstock. This system requires no countershaft and is fairly representative of the fit up of lathes used for short work in the machine shops. To use shifting gear on these lathes is too slow and a waste of time, as the operator gets so proficient in knocking off the belt and either stopping his lathe or changing his speed that much time is thereby saved. It is simply wonderful the dexterity acquired in handling the belts as almost every job requires the lathes to run at three or four speeds during the operations, from roughing to the finishing process, and with the short space of time required to operate each process, were striking gear used, the cost of turning the article would be doubled. The various articles shown in Fig. 3, were turned on the lathes in Fig. 4 and were selected at random to illustrate this article, and they are only a few of the varieties going through the works daily.

The Work Produced and the Workmen

The firm producing this work has the reputation of making high class and well finished machinery and is so busy that it is to build larger works to cope with orders.

The greatest difficulty connected with hand turning is the obtaining of competent

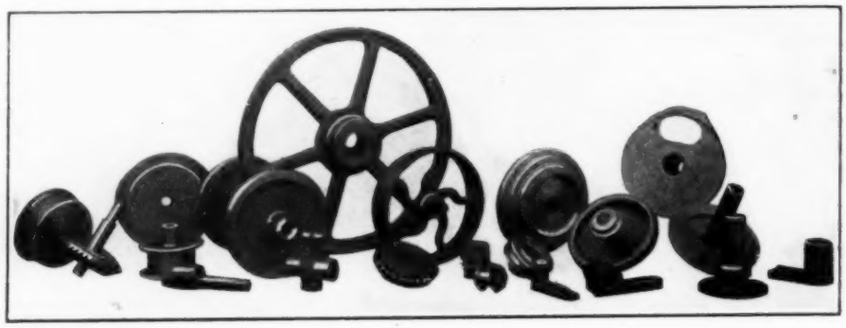


FIG. 5. HAND-LATHE WORK

workmen, as the hand lathe is confined practically to a limited area where it has always been in use.

Probably one reason for this is, that, hand turning requires a high degree of technical skill which takes a considerable time to acquire, and very often after many years of experience many workmen fail to become proficient. Others prefer the slide lathe as being less monotonous, and the apprentice to the latter is more easily trained to the work of operating the self-acting and automatic machines. Under these conditions employers have a much greater choice of men. The apprentice to hand work, usually commences by turning cup-head bolts, hexagon nuts, etc. These he will finish at the rate of six or seven gross per day. And from this work he progresses until he becomes proficient in the work executed in the shop he happens to be in.

In connection with brass work, hand turning is much more extensively carried out and may be looked on as general in shops not doing special work. Hand turning is also used in instrument, and copper work. But as such work comes into an entirely different field than this article is intended to cover further reference will not be made to it here.

According to the *Engineer*, a gardener of Minneapolis is said to have obtained remarkable results from the effect of electric light on vegetation. He planted a bed of lettuce plants 2 inches high. At one end of the bed he placed an arc light, which was turned on each day at sunset, one-half the bed being shielded from the light by a curtain. When an investigation was made it was found that in the dark bed the lettuce was 7½ inches high, while that under the electric light was 8¾ inches. The heads under the influence of the electric light weighed 40 per cent. more than those grown regularly.

A Planer Chuck and a Gear Planer

By A. E. Robinson*

This chuck is designed to plane taper and parallel work. The top is hinged on the base of the chuck so as to obtain any taper per foot desired.

For planing parallel work, the adjusting screw is released and the top plate is dropped on positive stop points on the base. This guarantees perfect parallel alinement. The top plate has slots planed ¼ inch wide and ¾ inch apart. This allows a wide range of work and leaves a perfect bearing surface for the work.

The inclined shoe that guides the clamp has two tongues which bear in the bottom of these slots. This prevents burring or damaging the accuracy of the plate. The shoe is made of steel and planed at an angle of 50 degrees.

The clamp is made taper so as to be able to clamp very thin work and still be strong where the strain is applied. It is notched in the center to fit a rocking washer. The clamp is slotted to allow it to be placed on any angle without interfering with the bolt.

The jaw of the chuck is planed ½ inch deeper than the surface of the top plate. This slot is about 1 inch wide, which allows the steel strip to be placed in the slot that is lower than the work, so as to allow the tool to pass over the work and not interfere with the jaw proper. This also protects the jaw from being bruised by rough castings.

For holding work that requires a clamping pressure at any special hight, all that is required is to place a piece of metal the thickness of the hight desired under the toe of the clamp and by tightening the bolt, the work will be held perfectly accurate.

*General superintendent, American Tool Works Company, Cincinnati, O.

Gear-planing Attachment

This attachment was applied to a 24x24-inch by 6-foot American planer.

A is the work-carrying spindle, on which is mounted at the rear behind the cross-rail of the planer, the index wheel. This wheel has two rows of holes used independently for gears of different numbers of teeth and is actuated by a worm and worm wheel through the crank *C*, shown at the top. The wheel is locked by index pins controlled by the levers *D* and *E* as the case requires, only one lever being used at any one time, the other being withdrawn and locked.

B is the rail with adjustable stop block to take the thrust of the tool. *F* is a tool-centering device and fits into the center slot of platen but is not adjustable.

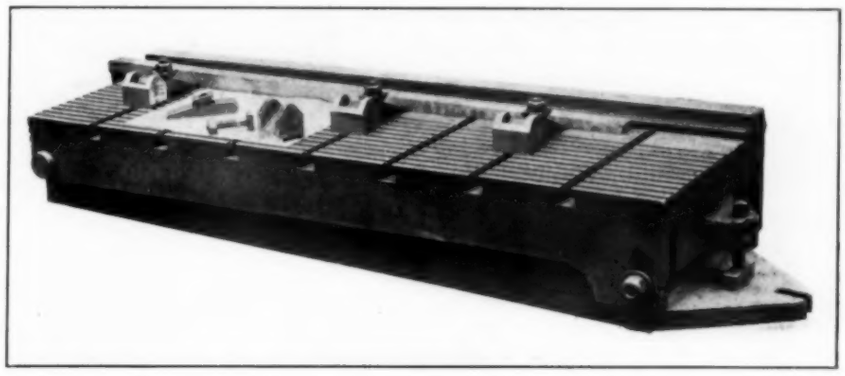
G is the tool head for vertical adjustment, being actuated by crank handle shown at the front. A micrometer dial is carried on the crank-shaft to facilitate accurate work. Directly in the center of the vertical slide is a depth stop which does not show in the illustration.

The tool head proper is mounted on a base plate with a tongue at right angles to the planer platen, which permits the head being moved transversely for centering the tool. The tool is carried in a box similar to and acting in the manner of those used on all standard types of planers.

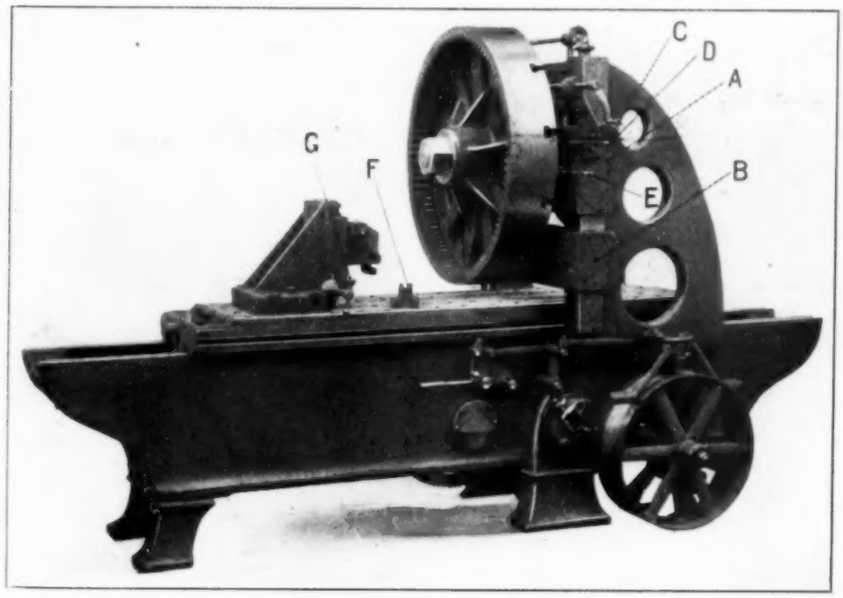
Two tools are used, a square-nose tool for roughing, and a form tool for finishing. The form tool is so made that it may be ground on the front face without changing its shape.

The work produced on this machine is practically perfect and consumes much less time on this particular class of work than was formerly required when done on a standard gear planer.

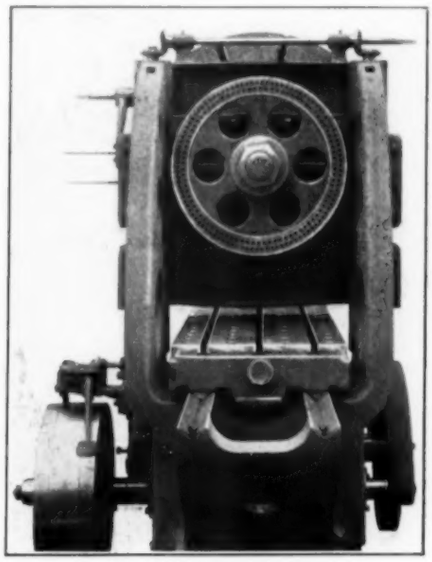
The advantage of holding the work and permitting the tool to travel can be readily appreciated on account of the difference in the weight of the respective bodies.



A SUBSTANTIAL PLANER CHUCK



A PLANER FOR INTERNAL GEARS



THE INDEX PLATE ON THE PLANER

A French Tooth Rounding Machine

By Wm. F. Groene*

The use of gear drives and gear feed boxes has developed the necessity for rounding the ends of the teeth in sliding gears used for machine-tool construction, as well as in the automobile industry, to insure positive and easy meshing when they are slid together, and we show herewith a machine for this purpose, built by Lejeune, of Paris, and imported by the R. K. LeBlond Machine Tool Company for this purpose.

The cutter is held in place by a draw-in collet at the lower end of the spindle which is driven by the pulley above through spiral gearing. The cutter head swivels in order to allow the cutter to be set for proper rounding of the tooth. The gear itself is held on the horizontal arbor which is revolved continuously by the large gear at the left having 175 teeth, the adjustable friction band on the inside of this wheel takes up all slack and prevents back-lash. The feed belt shown coming down behind the right-hand end of the tool-head slide furnishes the motion which moves the milling cutter back and forth along this slide under the control of a cam which moves it in and out from one space to the next and around the end of the tooth so as to leave it with the end rounded as shown on the gear lying on the machine in Fig. 1. The knob directly over the finished gear is attached to a sliding key which gives the changes of gearing for the index. Fig. 2 shows a general view of the machine, in which can be seen the mechanism over the top of the large driving gear for varying the stroke of the slide, as shown in Fig. 3. At the back side of the driving gear can be seen the change gears for the feed and in front of these is the device by which the spindle can be disengaged from the wheel so that the teeth of the gear to be cut can be set to suit the cutter.

The cutter is moved around the edge of the tooth by the cam in Fig. 3, acting on the arm shown, which fulcrums on the screw and moves the slide on the housing by the pin at the lower end. By adjusting the shoe up or down in the dovetail slot, the relative length of the two arms are changed and the slide movement is altered according to this adjustment.

*Chief draftsman, R. K. LeBlond Machine Tool Company.

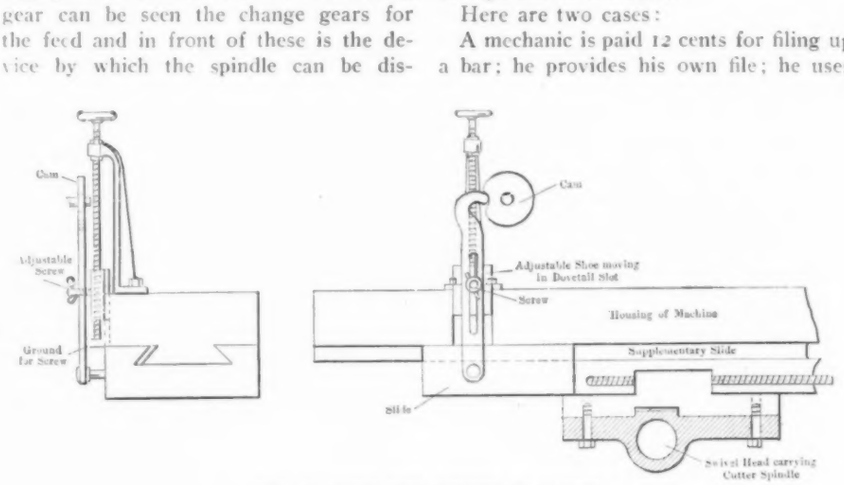


FIG. 3. HOW THE STROKE IS VARIED

File Efficiency

By M. J. Grange

An exceptionally long-life file is to be viewed with suspicion: keen cutting edges and long life are a contradiction, and foreign one to the other.

Here are two cases:

A mechanic is paid 12 cents for filing up a bar; he provides his own file; he uses a file that will last him a day, and with it finishes 12 bars. His net earning is

12 bars @ 12 cents	$1.44
Less—1 file	.24
Net earning	$1.20

He hears of a very fast cutting file, and buys one; at midday he has filed 8 bars, but his file is worn out; he buys another, and at the end of the day has finished eight more bars, but his second file is also worn out. At first he blames the file

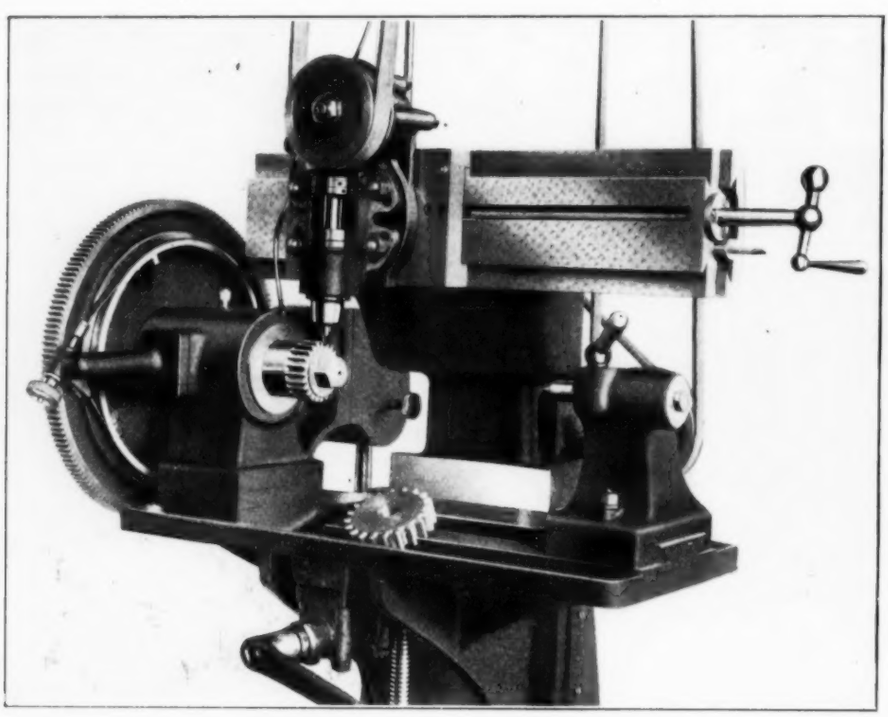


FIG. 1. FRENCH GEAR TOOTH-ROUNDING MACHINE

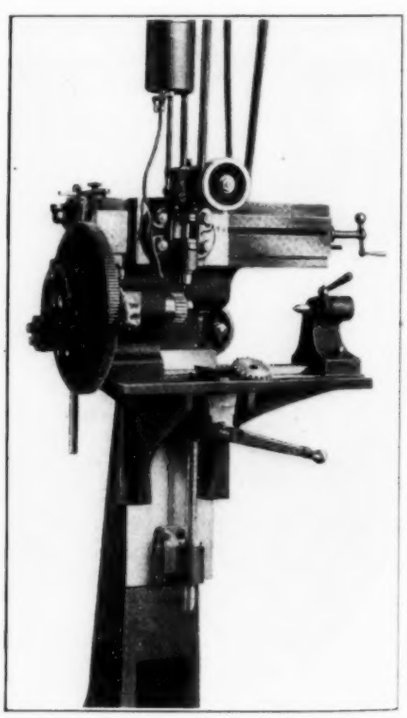


FIG. 2. THE INDEXING END

for its short life, but soon praises it when he works out the result of the day,

16 bars @ 12 cents	$1.92
Less—2 files	.48
Net earning	$1.44

Keen edges are only obtained on fragile foundations—not brittle, but fragile. An edge can be put on a square bar but it can never be as keen as one on a sharp angular piece.

For cutting metal *fast*—it is necessary to have a sharp fragile edge, so tempered as to give the maximum durability, which can only be obtained by the use of the best possible high-carbon crucible cast steel. This has recently been recognized by the admiralty in placing their contract for files.

Such a file cannot be produced at a low price, except by the manufacturer so changing his patterns as to employ thinner blanks and economize in the amount of material used. This will produce a good quality file at a lower price than he could furnish a heavier pattern for. Recutting has been proved to be an economical fallacy here, therefore there is no necessity for more steel to be used in a file than will make it strong enough for the work put upon it.

An hour's wage costs as much as a 12-inch file, so look out for the fastest-cutting file and throw it away immediately it loses its maximum speed in cutting. The result will be greater production, at the expense of a slightly increased file bill, which will be very small in comparison to the reduction of cost.

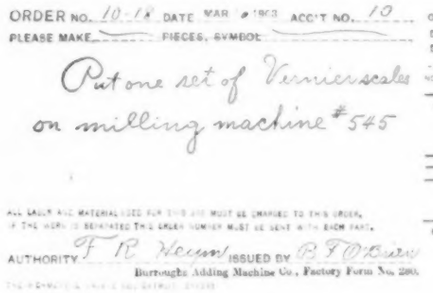

ORDER NO. 10-18 DATE MAR 16 1908 ACCT NO. 10
PLEASE MAKE PIECES, SYMBOL
Put one set of Vernierscales on milling machine #545
AUTHORITY F R Hearn ISSUED BY B F O'Brien
Burroughs Adding Machine Co., Factory Form No. 280.

FIG. 2. FORM 280 FACTORY ORDER

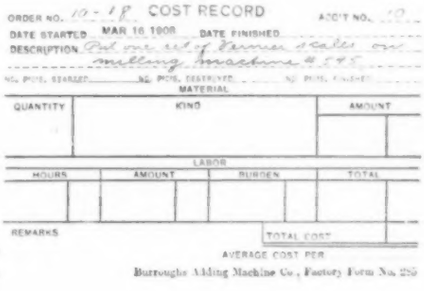

ORDER NO. 10-18 COST RECORD ACCT NO. 10
DATE STARTED MAR 16 1908 DATE FINISHED
DESCRIPTION Put one set of Vernier scales on milling machine #545
MATERIAL
QUANTITY KIND AMOUNT
LABOR
HOURS AMOUNT BURDEN TOTAL
REMARKS TOTAL COST
AVERAGE COST PER
Burroughs Adding Machine Co., Factory Form No. 285

FIG. 3. FORM 285 COST RECORD

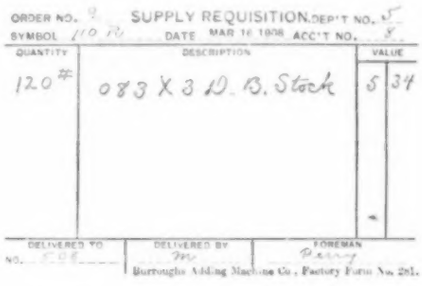

ORDER NO. 9 SUPPLY REQUISITION DEPT NO. 5
SYMBOL 110 P DATE MAR 16 1908 ACCT NO. 8
QUANTITY DESCRIPTION VALUE
120 # 083 X 3 10. B. Stock 5 34
DELIVERED TO
DELIVERED BY
FOREMAN
Burroughs Adding Machine Co., Factory Form No. 281.

FIG. 4. FORM 281 SUPPLY REQUISITION

The world production of zinc in 1907 was 738,400 tons, which is an increase of 5 per cent. over the preceding years; the United States with 226,838 and Germany with 208,700 tons being the chief producers of this metal. In the same year the principal zinc consumers were: United States, 200,000; Germany, 174,900; Great Britain, 140,300, and France, 69,600 tons.

Balanced Cost Accounting

By A. J. Doughty*

The accompanying half-tone, Fig. 1, shows the cost department of the Burroughs Adding Machine Company, at Detroit, Mich.; the method of conducting it may be characterized as "balanced cost accounting by filing original records and making use of the Burroughs adding machine."

This cost-keeping system may be briefly described as follows: The standing accounts are subdivided into orders for the purpose of obtaining the cost of any particular lot or job. When the order, Fig. 2 (factory form No. 280), is issued, the first part of the cost record, Fig. 3 (factory form No. 285), is made out and filed under its proper account in the cabinet, shown in the background of Fig. 1. The

*Factory manager, the Burroughs Adding Machine Company.

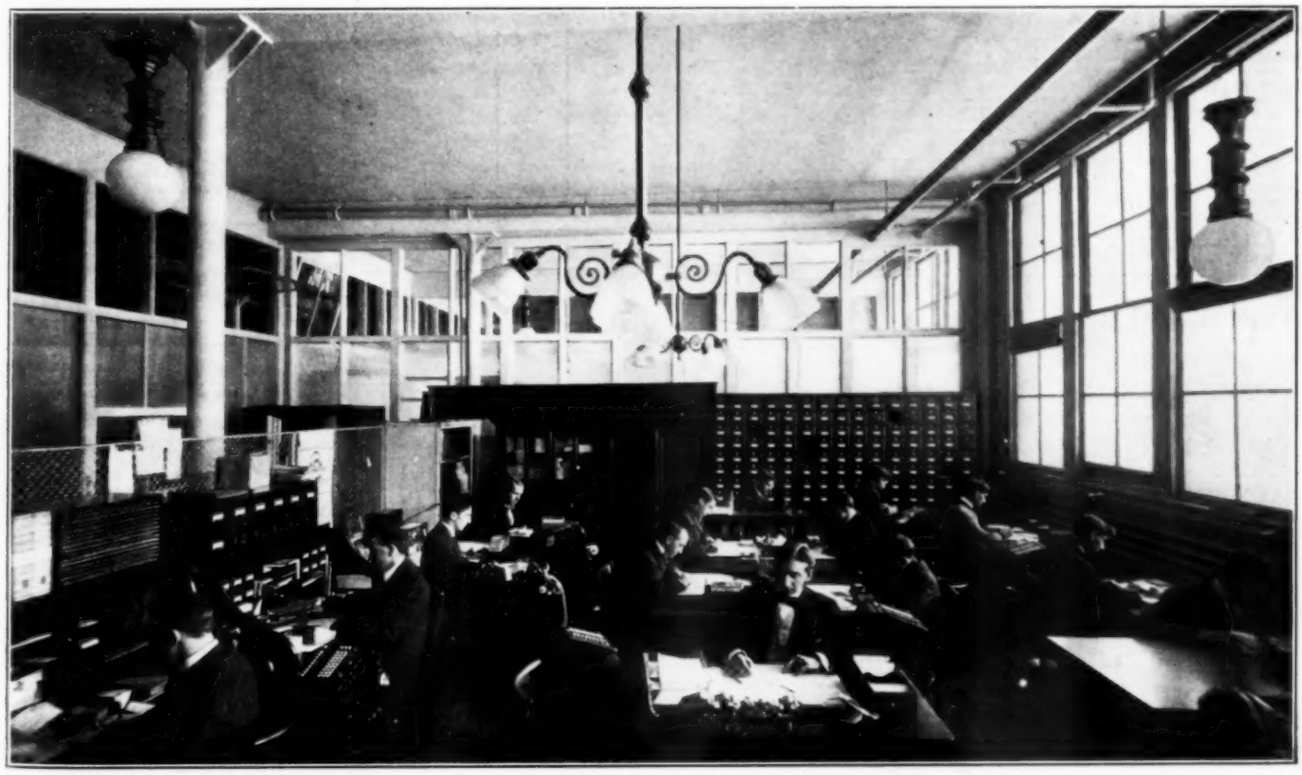


FIG. 1. COST DEPARTMENT OF THE BURROUGHS ADDING MACHINE COMPANY SHOWING ADDING MACHINES IN USE

order is then sent to the foreman who starts that class of work and who must see that all supply requisitions, Fig. 4 (factory form No. 281), and time tickets, Fig. 5 (factory form No. 275), for this order have the correct order number. All destroyed work is reported by the inspectors on tickets for destroyed pieces, Fig. 6 (factory form No. 276).

Each workman registers his time on a clock card, Fig. 7 (factory form No. 292), from which the timekeeper fills out a timekeeper's daily report, Fig. 8 (factory form No. 277). The workmen fill out the time tickets, using a separate ticket for each account or order worked upon each day. The timekeeper's daily report and the time tickets are indorsed by the foreman of the department, or his assistant, and sent to the cost department the following morning. The time tickets are then extended, separated into accounts and footed on one of the special Burroughs machines, shown on the right of the half-tone, which adds the hours and amounts simultaneously (see Fig. 9). As this list is usually a long one, a section only is shown. The items at the top show part of the hours and amounts taken from the time tickets and charged to account No. 8, together with the totals for that account. The remaining figures show the account numbers with the total hours and amounts charged to each. These totals are balanced with the timekeeper's daily report on the daily proof report (factory form No. 287), Fig. 10, showing an exact balance between the time- and cost-keepers daily.

All cost records, supply requisitions, time tickets, reports of destroyed pieces, etc., are filed by their respective numbers. As each order is finished its records are taken from the file, computed on the adding machine and the information pertaining thereto entered on the cost record.

The orders for standard parts or symbols are filed by symbol numbers, being separated in the files by an index card on the front of which is a blueprint or photograph of the piece and on the back a list of the regular operations, by numbers, together with their standard or average cost, the piece-work prices being given in red (see Fig. 11).

The symbols are subdivided into operation numbers by the cost record of operations (factory form No. 278), Fig. 12. As the operations are finished the hours and amounts of the time tickets of each different workman are footed and the amount divided by the number of hours showing his earnings per hour (see Fig. 13). The workman's number, 199, and the operation number, 70, are printed at the top of the

TIME TICKET — DEPARTMENT NO. 1

WORKMAN'S NAME		DATE	WRKMN'S NO.
S. Torens		1-20-08	182

ORDER NO.		BOX NO.	NO. PIECES	ACCOUNT NO.
2	110R	1538	1245	8

OPERATION	TIME	RATE	AMOUNT
70	8¼	22	2 73

REMARKS

TIME STARTED — TIME FINISHED

FOREMAN'S O.K. J W B

B. A. M. CO. 208636 — BURROUGHS ADDING MACHINE CO., FACTORY FORM NO. 275

FIG. 5. FORM 275 TIME TICKET

ORDER NO. 2 DESTROYED PIECES ACCOUNT NO. 8

SYMBOL 110 R BOX NO. 1538 NO. PC'S IN BOX 1245

WORKMAN'S NO. 182 WORKMAN'S NAME Paul Jones DEPT. NO. 1

NO. PIECES 2 COST OF MATERIAL COST OF LABOR

REJECTED ON ACCOUNT OF

OPERATION 70 TOTAL VALUE

REMARKS DATE 1-20-08

INSPECTOR J S Barnes SIGNED

Burroughs Adding Machine Co., Factory Form No. 276.

FIG. 6. FORM 276 RECORD OF DESTROYED PIECES

Burroughs Adding Machine Co.

999

No.

Name Paul Jones

Rate 30

Due 14 18

Week Ending 190

DAY	IN	OUT	IN	OUT	IN	OUT	DAILY TOTALS
FRI	1 30		1 26				
SAT	2 15						
SUN							
MON	4 17		4 03				
TUES	5 03		5 07				
WED	6 11		6 11				
THUR			7 36	7 49			

Total Time 47 25

Received Payment Paul Jones

B. A. M. CO. FACTORY FORM NO. 292 207362

FIG. 7. FORM 292, FRONT AND BACK OF A CLOCK CARD

No. 999

Name Paul Jones

This Side Out.

REMARKS	AMOUNT

TIME-KEEPER'S DAILY REPORT.

DEPARTMENT NO. 9 DATE Jan 9th - 08

LIST AND CLASSIFY UNDER PROPER HEADING: ABSENT, LATE, PASS OUT, QUIT, STARTED, OVERTIME & ALLOWANCE, AND CHANGES OF RATE.

NO.	NAME	HRS	AM'T	NO.	NAME	HRS	AM'T
	Absent				Started		
900	Smith	7½	2 00	705	Kellar	7½	1 95
926	Brown	7½	1 90				
999	Jones	5	1 50		Transferred to		
				706	Grimes	7½	1 75
	Late					19½	3 90
903	Waller	½	15				
999	Jones	¼	08		Quit		
				901	Miller	7½	2 62
	Pass Out						
904	Gordon	1½	55		Transferred from		
		21 ¾	6 18	709	Gordon	7½	3 03
						19½	5 65
	Overtime						
907	Waller	4½	90		Change of Rate		
908	Kellar	2½	75	902	King	4½	1 29
		7	1 65				

TIME-KEEPER Robt Reid FOREMAN Geo Porter

Burroughs Adding Machine Co., Factory Form No. 277.

FIG. 8. FORM 277 TIME KEEPER'S DAILY REPORT

DAILY PROOF REPORT. DEPT NO. 9 DATE Jan 9th 08

RECEIPT NUMBERS	HOURS		AMOUNT			HOURS		AMOUNT	
3	19	½	8	09	PRECEDING DAYS ALLOTMENT	780		165	78
					PLUS NEW EMPLOYEES	19	½	3	90
5	19	½	2	05		799	½	169	68
					MINUS EMPLOYEES QUIT	19	¼	5	65
6	9	¾	1	95		780		164	03
					PLUS OR MINUS CHANGES OF RATE				29
8	716	½	147	68					
					PRESENT ALLOTMENT	780		164	32
					PLUS OVERTIME AND ALLOWANCE	7		1	63
						787		165	95
					MINUS, ABSENT AND LATE	21	¾	6	18
TOTALS	765	½	159	77	PAY ROLL	765	½	159	77

Burroughs Adding Machine Co., Factory Form No. 287.

FIG. 10. FORM 287 DAILY PROOF REPORT

500
STYLE #9 500-

STYLE 9-7.904 E

GRIND .3125 A

BURROUGHS ADDING MACHINE CO. CLEVELAND, O.

SCALE 1 CHANGE MADE

© Standard Cost per Hundred Pieces.

Material. 8.598

| Operation No. | | | | | | |

list, the hours and amounts on the time tickets added, and the amount divided by the number of hours, showing his earnings

	2	60
	5¾	2.01
	7½	2.72
	9	2.25
	5¾	1.44
	7	1.75
	2¾	69
	¾	26
	2¼	61
	7½	1.72
	5½	1.38
	3½	1.05
	7½	1.65
	½	17
8	716½	147.68*
3	19½	8.09
5	19½	2.05
6	9¾	1.95
8	716½	147.68
	765¼	159.77*

FIG. 9. SPECIMEN LIST SHOWING HOW TIME TICKETS ARE FOOTED BY THE ADDING MACHINE

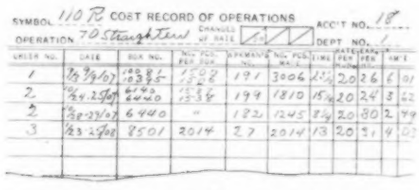


FIG. 12. FORM 278, COST RECORD OF OPERATIONS

199	70†
	*
1½	38
2¾	54
9¾	2.10
1¼	60
15¼	3.62*
1,525	†
	362.00
	9,847.50
	9,847.50
	984.75
	984.75
	984.75
	23,011.25*
	1.90
	2.70
	10.50
	3.00
	18.10*
20	†
	181.00
	181.00
	362.00*

FIG. 13. SPECIMEN LIST SHOWING HOURLY EARNINGS OF A WORKMAN

per hour to be $0.23 $\frac{113}{128}$, or practically 24 cents. The number of pieces shown on the time tickets are footed and compared with the number on the order, and the number of pieces multiplied by $0.20, the rate per 100, proving that the time tickets were extended correctly. These items are entered on the cost record of operations.

At the close of each week's business a trial balance is made on the adding machine showing the hours, amounts, supplies, and totals by departments and accounts; these are balanced with the payroll and supplies issued by the stockkeeper.

Turret for Cartridge Cases

The machining of the head of cartridge cases or shells, such as turning the rim, facing the end, drilling, counterboring and tapping the fuse plug hole is not a heavy or a difficult job except for the inconvenience of getting the work in and out of the chuck.

This problem was solved by the Bardons & Oliver Company, Cleveland, O., by hinging the head of the turret on a large stud *C* by means of the circular rack shown. This is operated by a pinion driven through bevel gears by the handle *A* and the head is locked in position by a pin in the hardened-steel bushing in the top of the bed, under control of handle *B*.

The front end of the head is gibbed down as shown, the gib covering and protecting the circular rack when the lathe is at work.

Operations are started by swinging the head as shown, inserting the cartridge case and closing down the collet by the hand-wheel on spindle head. To prevent the spindle turning while this is being done, the handle *G* is moved to throw a locking pin into the large spindle pulley and is withdrawn after the chuck has been closed on the work. Then the head is swung into line and locked.

The cut-off slide carries three tools which face the inside of the flange, face the end and chamfer the edge of flange, and each tool is independently adjustable.

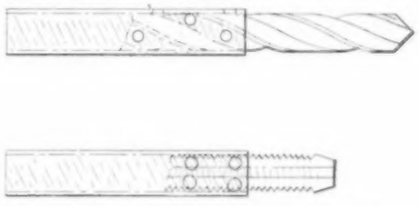
Cases which are long enough to project through the head are faced off by the back slide, being supported by expanding bushings located on bar *D* which is carried by support *E*. These bushings also serve as stops for locating the position of the cases in the spindle. When completed they are forced out by the ejector seen in the front of the spindle and operated by the lever *F*. The drilling, counterboring and tapping are done by the turret with regular tools.

Some of the main dimensions are spindle bearings, front 9½x8 inches; back 8½x5½ inches; hole 7⅛ inches; pulley 20 inches; swing over bed 26 inches; over slide 7⅛ inches.

Using Up Broken Drills and Taps

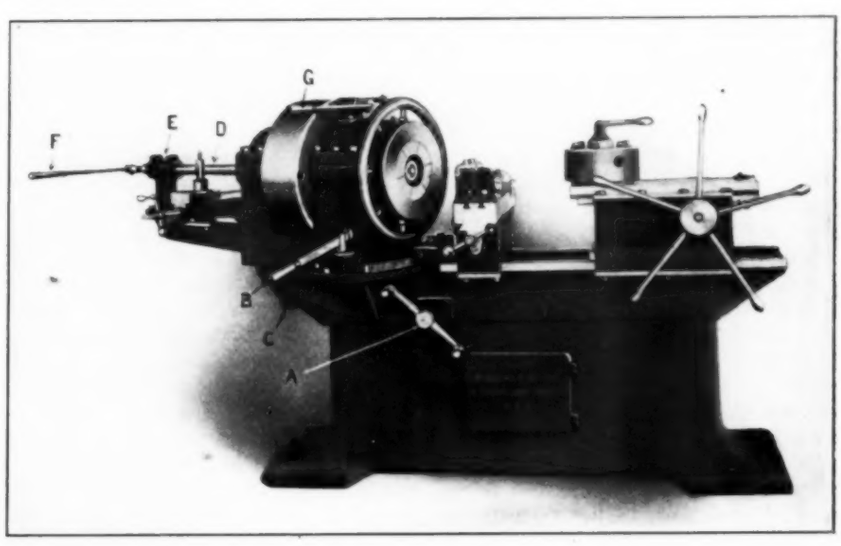
The Rockford Drilling Machine Company, Rockford, Ill., sends us its device for using up the short ends of taps or drills which have been broken off.

This is very simple and consists of a



USING UP BROKEN DRILLS AND TAPS

piece of brass or iron tubing. Three or four holes are drilled into the tubing and melted babbitt, or lead, is then poured into the tubing. The holes in the tubing are put there for the purpose of anchoring the babbitt. By this simple device the broken ends of twist drills can be used very sucessfully.



TURRET LATHE FOR TURNING CARTRIDGE CASES

An Index Die for Armature Punchings

By K. S. Allen

I have read with interest and profit the various die articles that have appeared in the American Machinist for a number of years, but I do not remember having seen anything at all like an index die that is used extensively by one of the large electrical firms of this country for slotting armature punchings. Who designed them, or when the first one was made I do not know. I first saw them about 10 years ago. So far as I know there never was a drawing made of any part of them. I was connected with the tool department of this firm for a number of years. My duties made it necessary for me to know the construction of the dies. I took a number of notes and sketches to assist me, and from these I have obtained the data for this article.

Dimensions given on the parts of the die I can vouch for. All the dimensions on the punchings, except the thickness, I have assumed for the purpose of illustrating the construction of the die. However, they are not very far from some dies which were made. Doubtless we made as many as 50 of these dies in five years, and it always seemed to me that, for cheapness and efficiency, they were as good as anything I ever saw in the die line. Of course, compound dies may be made to produce such punchings when they are wanted in quantities large enough to justify the making of such an expensive tool. I expect to have something to say in another article about compound dies as they were made and used by this same firm.

The material to be cut is always soft sheet iron, not over 0.028 inch thick, while most of it is 0.016 inch thick. It is always blanked out to correct diameter outside and inside and the keyway cut with a blanking die. The usual practice in the press room is to punch two sheets at a time of the 0.016-inch thickness.

The punching used for illustration in this article is indicated by a broken line at *X*, Fig. 1. It is in position on the index plate and the slots have been punched. It is 27 inches outside diameter, 20 inches inside diameter, with a ½-inch keyway, which fits over the piece *H* and prevents it from rotating relative to the index plate. It has 94 slots.

The first thing to be settled when preparing to build these dies is, how many punches are to be used? It might be supposed at first thought that it would be necessary to make the number of purches such that they would divide evenly into the number of slots required in the punching; but such is not the case. In selecting the number of punches to use, two things are considered, first, to use as many as practicable without making the die block too large. If this happens to be a number that will divide evenly into the required number of slots all well and good. More often than otherwise they do not come even. Then the second thing to be watched is to see that they do not come too near even, for in that case the first and last notch in the index plate will interfere. Six punches can be used to best advantage for the punching under consideration.

The component parts of this tool consist of a cast-iron die shoe *B*, Fig. 1, a die *D* of tool steel about 8x5x1⅛ inches thick, with six openings to receive the punches. It will be noticed that the openings are about 1/32 inch longer than necessary to make the slots. The punches are made to suit these openings; this insures clean slots. The three round openings indicated opposite the punch holes are simply drill holes put through to help equalize the internal strains caused by hardening. The die is held in position in its shoe by two set-screws *M* and a stop pin *O*. The ends of the die are cut at an angle of 15 degrees from the vertical. The set-screws are ½ inch diameter, of hardened tool steel, and have a round point which takes its bearing on the die itself without any gib of any kind. Inadequate, it always seems to me, yet it is the standard method of holding such dies in that factory and has been for years. The only trouble I ever heard from it was that the set-screws got used up very fast, which I suppose is evidence that they sometimes do not hold well and the operator used a large wrench on them; although the fact that a die setter uses a large wrench on a small screw is not always proof that the screw would not do its work if it was set up with a wrench of suitable size. The trouble from this source was so small as to get no consideration when it was compared with the advantages gained by this simple method of holding the dies.

The index plate *U* is a forging. Some of the small ones are made from a solid plate without arms, but all of the large ones are made as shown, with a hub and arms. They are all made of the same thickness and the hub and arms are approximately the same size. This index plate is mounted on a standard center, which consists of three parts *V*, *W* and *Y*, Fig. 2. It may be well to state here that the section shown in Fig. 2 is a vertical section taken on line *A A*, Fig. 1. These centers are made up in lots of a dozen or more and serve their purpose to perfection. The part *V* is of machinery steel. The top end has a thread ⅝ inch long, 2½ inches diameter, 8 per inch externally. Internally it has an opening which is a mutilated thread of very coarse pitch with only one-quarter of a turn on each side. This opening was designed to receive a suitable plug to clamp the punchings, but in most cases it was not necessary to use this clamp. The lower end is a taper bearing 1⅜ inches diameter at the large end, 1¼ inches long. The taper is 10 degrees from the center line, or 20 degrees included. The part *W* is a hard bronze bushing with an external thread 1⅝x12x1 inches long. The head is 2 inches diameter, notched to receive a spanner wrench for use in adjusting the index plate to suit the die. The screw *Y* is 7/16 inch diameter with a very large head.

Returning to the index plate. The machining of it has no special features until it comes to making the index notches. These are of the shape indicated with their effective sides at an angle of 60 degrees to each other. To notch this plate, set the index head on the milling machine to cut 94 notches. As we are to use six punches cut only every sixth notch, $\frac{94}{6} = 15\frac{4}{6}$. Starting at the notch that is engaged by the index hook *E*, Fig. 1, and notching around the plate clockwise, cutting every sixth division, until 17 notches are cut. The last notch will over-reach the first one by the amount of two slots; hence the plate is divided into 15 equal spaces of six slots each and four-sixths of a space or four slots. The two-sixths of a space over-reaching into the first space does no harm whatever. Sixteen strokes of the press complete a punching.

The operators have no trouble in getting the swing of things in a short time, so that the press runs continuously from start to finish of each punching.

The punch member consists of four principal parts *P*, *Q*, *S* and *T* of Fig. 2. The part *P* is known as the punch holder and is of machinery steel; *Q* is the punch plate, also of machinery steel. Fig. 4 is a plan view of this plate ready to be fastened to the under side of *P*, with No. 14-24 flat-head machine screws and two dowels. The punches proper are indicated by *T*, and are of tool steel hardened and ground with the top end annealed, so that they may be riveted into the punch plate *Q*; *S* is a stripper plate of machinery steel, and is bolted at each end to the press ram in such a manner that pieces of rubber are used for springs and drive the plate low enough to strip the punches clean.

The die *D*, punch plate *Q* and stripper plate *S* are all made with openings located exactly the same. To accomplish this a templet is made of sheet brass about ⅛ inch thick. To lay out this templet it is necessary to find the value of the chord *C*, Figs. 1 and 4. The value of *R*, number of slots and the size of the punches can all be taken from the drawing of the punching. Of course, *C* and *R* may be taken to the outside of the punches if one prefers. The method of finding the chord is the same. To find chord *C*: Let n = the required number of slots, let n_1 = the number of punches used, let n_2 the number of punches minus one and let R = the radius. There are 360 degrees in a circle, but since the number of slots required will seldom divide into 360 even, it is better to reduce the whole circle to minutes, $360 \times 60 = 21{,}600$.

Then $\frac{21,600 \times n_1}{n}$ = minutes spanned by the chord C.

If one has a table of chords given to degrees and minutes, it is only necessary to take from this table the value corresponding to the minutes found by the above formula and multiply it by the value of R to obtain the length of the chord C.

$\frac{1148.936}{2}$ = 574.468 minutes in half the angle.

This reduced to degrees, minutes and decimal parts of a minute equals 9 degrees 34.468 minutes. In a table of sines opposite 9 degrees 34 minutes find 0.1661951.

Our angle is more than 9 degrees 34 minutes and less than 9 degrees 35 minutes. The tabular difference is 2868. Multiplying this by 0.468 gives the proper amount to add to the sine of 9 degrees 34 minutes, $2868 \times 0.468 = 1342.224$. The decimal part of this number may be safely dropped when the first figure after the decimal point is less than 5, as it is in this case.

Then the sine of 9 degrees 34.468 minutes = 0.1661951 + 1342 = 0.1663293. As R = 12 seconds, then $0.1663293 \times 12 \times 2 = 3.9919$; whence C = 3.9919 inches. With the cord found, it is a simple matter to find the subdivisions for the four intervening punches with the dividers.

The index center is mounted in its proper relation to the die in a strip of 3x1-inch machinery steel G, Fig. 1. The outer end is threaded to suit the bushing W, Fig. 2, then slotted and a binding bolt N, Fig. 1, is inserted (this bolt is a common ⅜-inch machine bolt from the store room): G is then carefully bolted and doweled to the die shoe B. The index hook E, Fig. 1, is then mounted on B. This hook swings on a tool-steel pin Z, Figs. 1 and 3. This pin is a tight fit in the hook and a nice running fit in the bushing a. This bushing is pressed into the die shoe. As the die is worn down by grinding the head of this bushing is cut down to suit, and the index plate is let down by turning the bushing W. The hook E is held to its work by a spring F. A handle K of strap iron is pivoted on G and supported at its outer end by a strip of strap iron L bolted at one end to G and at the other end to B, as indicated in Fig. 1. This handle carries a ratchet hook J pivoted to it. This hook is held to its work by a spring I. Springs F and I are so proportioned that by operating the handle K the index plate can be rotated with ease, at the same time it is held in place securely by the hook E when at rest. Both hooks E and J are made of machinery steel with their working ends case-hardened. They are smooth forgings about ½ inch square. The notches in the index plate are used just as they come from the milling machine.

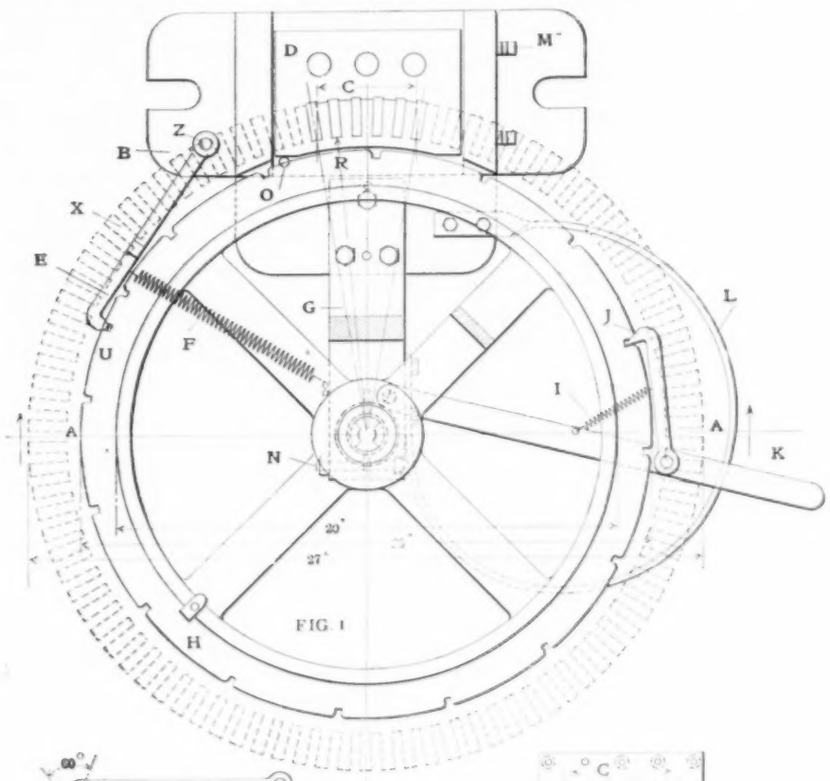


FIG. 1

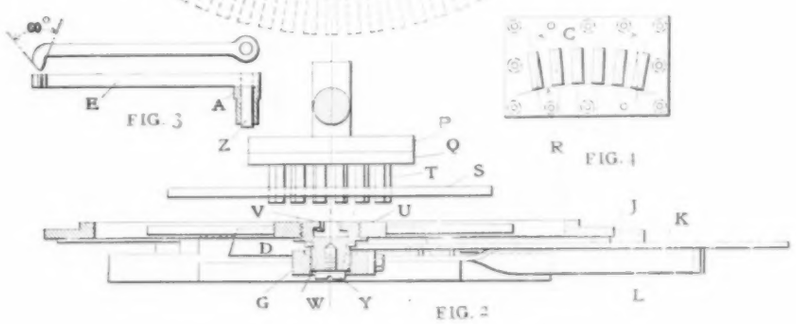


FIG. 2

FIG. 3

FIG. 4

AN INDEX DIE FOR ARMATURE PUNCHINGS

I am aware that few tool makers own a table of chords given to degrees and minutes. It may interest some to know that "Chamber's Mathematical Tables" is a book that may be obtained for a moderate price, and contains such a table; also other trigonometrical tables.

The same result can be obtained from a table of sines, but not quite so readily, for the sine of half the angle multiplied by twice the radius equals the chord of any angle. In this case, R = 12 seconds, n_1 = 94 and n_2 = 5. Substituting these values in above formula:

$\frac{21,600 \times 5}{94}$ = 1148.936 minutes in the whole angle,

and

Sayings That Fit the Shop

Verily, the most necessary thing in a shop, store, bank, railroad office or factory, is to keep the peace.

He who scrappeth not with his neighbor, and shutteth up and closeth his gob, is getting a cinch on the foremanship.

And the foreman who smothereth a feud, and turneth the hose on the clique, is already engaged to the proprietor's daughter, and the painter is busy getting ready to put his name on the sign.

Beware of him who dealeth in fairy tales about his fellow workers, and for them maketh life difficult, for he is already putting salt on the tail of a blue envelop. —*Elbert Hubbard.*

A recent use of silicium in Germany to obtain a pure copper cast and copper alligation was successful. The foundry trade well knows the difficulties of pure copper casting, which difficulty rests primarily on the fact that in melted copper, unavoidably, copper oxides are generated. As a reduction agent phosphor is generally used, but late experiments by English experts prove that additions with silicium copper (pure silicium cannot be used) are preferable. They clean more effectively, harden and tighten better the copper structure and their alloys. The reason for this is that the unification of copper silicon has a higher effect than copper alone, and silicon impairs the oxidation.

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Jig for Machining Piston Rings

Piston rings for internal-combustion engines are usually turned all over and from their awkwardness to hold are frequently an expensive item in the machine shop.

Having a great quantity to manufacture, of varying sizes, we spent some considerable time experimenting and after trying various methods, with more or less success, the following were decided on for both concentric and eccentric rings and found to be good and cheap, which virtues do not always run hand in hand on machine work.

The rings were cast in pots in the usual way, rough-turned inside and out with a double tool on a boring mill, then cut off with a multiple tool with sufficient blades to cut up the whole pot with one feeding in, these being set slightly in advance of one another to insure the first being cut through before the next was too weak to drive.

They were then edged with a double

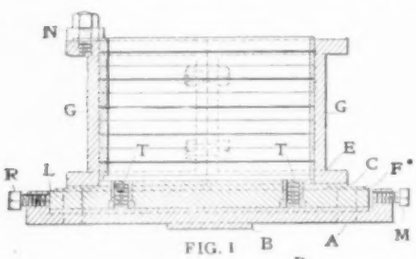


FIG. 1

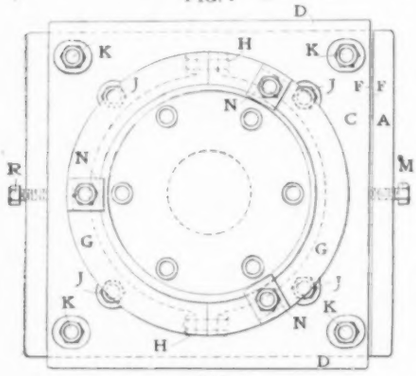


FIG. 2

BORING THE RINGS

tool on an expanding mandrel, also on a boring mill, which operation is unnecessary when clearance is given between the sides of ring and grooves in piston body, which is the practice of some makers.

A milling machine cut out what was necessary to give sufficient spring to the ring, after which they returned to a boring mill for the final operations of finishing inside and out, which were done with the help of the following jig.

In Fig. 1, *A* is an adapter with spigot *B* turned to fit table of mill. *C* is a plate free to move the required amount of

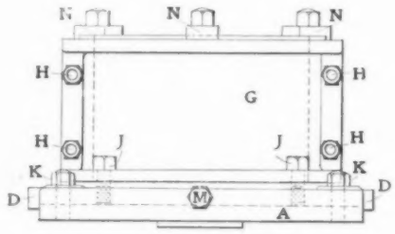


FIG. 5

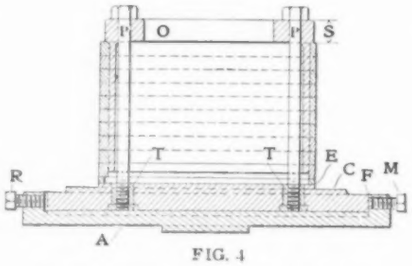


FIG. 4

MACHINING THE OUTSIDE OF RINGS

eccentricity endways on *A*, but prevented from side movement by lips *D D*. Spigot *E* is turned concentric with *B*, when faces *F*, Fig. 2, are together.

A pair of clamps *G G* are bored 1/32 inch larger than finished diameter of rings and held together by bolts *H*, and also fastened to plate *C* by tap bolts *J*.

Bolts *K K*, in Figs. 2 and 3, answer two purposes, holding *C* to *A* and the whole of the jig to table of machine, the holes through plate *C* being slotted to allow of it being moved endways when required.

To operate, place clamps in position as shown in Figs. 1, 2 and 3, close faces *I I* together by means of screw *M*; tighten all bolts, then place the roughed rings in position inside clamps, first inserting a thin packing ring to enable the cutting tool to clear at the bottom. When filled, fasten clamps *N*, and all is ready for boring.

After boring, insert bush *O*, clamping it down with bolts *P*. If this is not well done the rings will spring out when turning the outside.

Loosen bolts *H* and *J*, remove clamps *G G*, slacken *K*, unscrew *M* and bring faces *F* together by means of screw *R*, tighten bolts *K*, then finish to diameter required. Bush *O* may appear rather deep at *S*, and also the screwed bushes *T* unnecessary, but both are the result of experience paid for in the usual way.

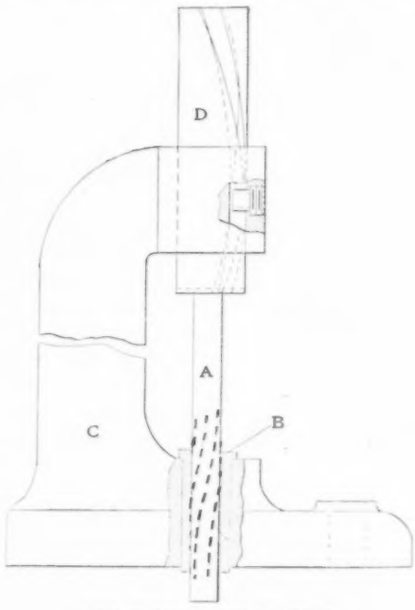
By having various clamps and bushes the same base will cover a large range of rings, and also by cutting more away at *L* they can be given any degree of eccentricity by the use of thin packings.

England. W. J. B.

Rifling a Bearing for Oil Distribution

A bearing, in which the shaft oscillated four thousand times a minute, became dry and cut. It was found impossible to distribute the lubricant over the whole surface because of the slight movement of the shaft, so we decided to broach grooves, for the oil, in the bearing. The broach was made as shown in the illustration at *A*. The part for the teeth was 3/32 inch larger than the body which was an easy fit in the bore of the bushing *B*. The shank was long enough to go clear through the bushing, and the end was tapered and provided with a pilot to steady it when entering the bushing.

The teeth were made by cutting a left-hand square thread about 4 per inch, re-



THE BROACH AND FIXTURE

lieving the back of the thread, then fluting in the milling machine and relieving the sides of the teeth. A fixture was made as shown at *C*. The top end of the broach shank was fastened in the sleeve *D*, which has a spiral groove in it the same pitch as the spirals on the broach. A pin in the fixture engages with the spiral groove, the

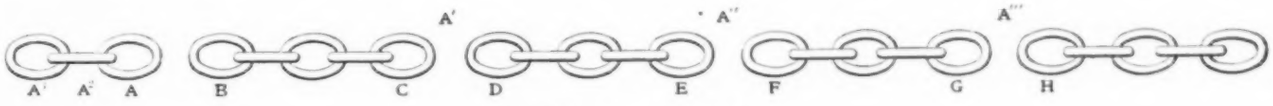
bushing is fastened in the base and the broach forced through it. This made a satisfactory job.

Jersey City, N. J. W. A. M.

Welding Chain

Here's a little trick in chain welding which is not commonly known:

Given a number of short pieces of chain to be welded together so as to form a long chain, say for instance five pieces, four with five links and one with three, as shown in Fig. 1, four welds would usually be necessary, but the chain can be joined in *three* welds if one of the lengths has three links. The same thing holds good with any number of pieces, provided one of the lengths has two links less than the total number of lengths to be joined.



THE CHAINS TO BE WELDED

The usual way would be to open link *A* and weld it through *B*; open link *C* and weld it through *D*; open link *E* and weld it through *F*; open link *G* and weld it through link *H*. In this way we have four welds.

The other method is to open link *A* and weld it at *A'* through links *C* and *D*; open link A^2 and weld it at *A''* through links *E* and *F*; open link A^3 and weld it at *A'''* through links *G* and *H*. In this way we join all the pieces with only three welds.

HENRY BARNES.

New York.

A Boring Tool

Sometimes the principle of a good idea will remain in one's memory long after the details of its origin are forgotten. A case of this is the design of a boring tool which I saw employed a good many years ago, but never having seen it described in any of the mechanical papers, I submit it to you.

This boring tool was used in boring long cylinders and tubes where it was necessary to remove the cutters for sharpening several times during a single bore, but the design was such that this could be done as often as necessary without encountering any difficulty whatever in resetting the tools to continue the bore on exactly the same diameter.

Fig. 1 shows one of the cutters in detail, while Fig. 2 illustrates the method of mounting the tools in the boring head. Several of the cutters were mounted in a single head which was carried on an ordinary boring bar having a screw feed.

The cutters are made of tool steel, properly hardened, and when first put in service are ground as at *A*. As they become dull on the cutting edge *B*, the face is ground back and a cutter can be used until it is ground down to the condition shown at *C*.

When the cutter is placed in the holder it stands at an angle of 60 degrees with the axis of the boring bar and presents a cutting edge parallel to it.

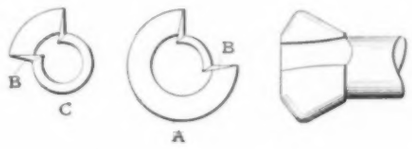


FIG. 1. THE BORING TOOL

After the first cut has been taken, shims are placed under the holder so as to raise the cutter to the proper hight for the final bore.

The cutters are held in the holder by a differential screw clamp, shown in detail in Fig. 2, while a pin at *D* prevents the holder from turning in the head. The feed is in the direction indicated by the arrow.

It will be readily seen that as the cutter is ground it is only necessary to replace it in the head so that the cutting face is in line with the center of the bar to maintain a continuance of the bore on the original diameter.

Worcester, Mass. H. H. G.

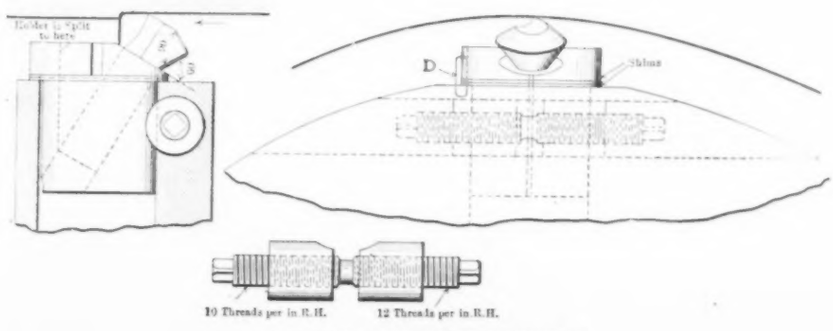


FIG. 2. THE METHOD OF MOUNTING

A Simple Method of Drafting-room Cost Accounting

In order to ascertain the wage cost for drafting, I put into use a card system. The drawing room is in the plant of a firm manufacturing automatic stokers and the drawing work consists, to a large extent, of layouts showing installations, each one of which requires an individual set of drawings. One of the reasons for starting to keep an account of the labor cost was to determine the amount of expense incurred by the different offices from the drawings they required.

Figs. 1 and 2 show the card which is used. On the face, in addition to the name, job number, etc., are listed six kinds of drafting-room work with spaces allowed for the hours spent on each class and total cost figures at the draftsman's wage rate. On the reverse, space is allowed for filling in the hourly record for one week's work. By using the number and initial to designate the nature of the work this hourly record will contain the information necessary for the final reckoning. On the assignment of a job to a draftsman, he is given a card properly recording the name, date, etc., and is required to fill out the hourly record as the job progresses. When the job is finished the card is returned and it only remains to fill in the spaces giving wage costs when the card constitutes a permanent record for the work performed. At the end of the week or month, as convenient, the several cards used by each individual draftsman are checked up with his record on the time register to insure against errors on his part in making out the card record.

In filing away the cards they are classified by a job number and filed numerically. By recording this job number on the file card for the drawing the wage cost for any drawing can be readily referred to.

Another satisfactory arrangement for general record purposes, is to classify the drafting work into a number of convenient divisions about as follows:

A. General layout drawings and installation records.

B. Detail drawings of special equipment on regular layouts.

C. Detail and assembly drawings of standard machine parts.

D. Detail and assembly drawings of shop equipment.

E. Standard dimension sheets and similar data.

F. Checking, filing, blueprinting and miscellaneous clerical work in the drafting room.

G. General work in connection with the shop, not contributing toward drawings.

Detroit, Mich. G. H. HAIGH.

A Multiple-piercing Die

The illustrations show a piercing die for piercing the eight holes *a a*, as shown at Fig. 1, at one stroke of the power press. Fig. 2 is a partial sectional elevation of the punch and die, and Fig. 3 is a plan of the die looking in the direction of arrow *E*. The die as shown in Fig. 2 is in the closed position, without the work. *F*, in Fig. 2, is a tool-steel ring beveled at the lower inner edge, and is driven down by the four punches *e*, located in the punch holder *K*. The bevel part of the ring *F*, working against the bevel of the outer jaws *G*, which carry the piercing dies *b*, shown in detail at Fig. 4, forces them toward the center of the die and they come to a stop as soon as the ring *F* reaches the straight part, after which the punch *H* continues to descend and drives the four inner jaws *I*, which carry the piercing punches *c c*, outward far enough to pierce the work. The work is, of course, between the piercing punches and dies with the flange of the work resting on top of the dies *b*. The inner jaws with the piercing punches and punch holder are shown in detail at Fig. 5; they work in the slots *d*, shown in the stake *M*.

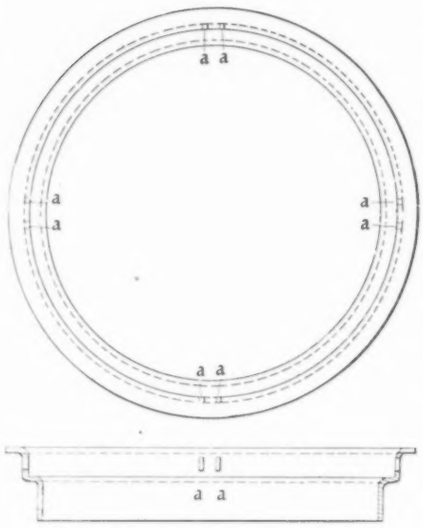


FIG. 1. THE WORK

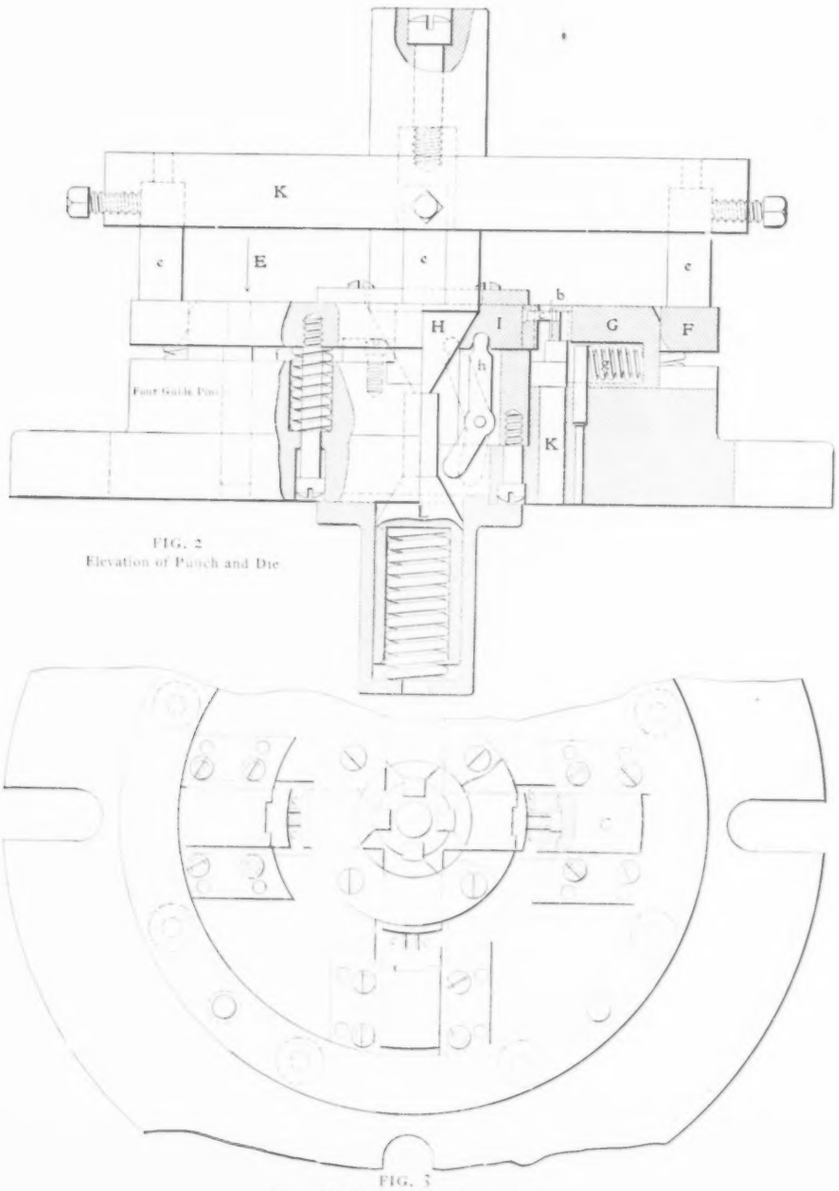


FIG. 2
Elevation of Punch and Die

FIG. 3
Plan of Die in Direction of Arrow E

THE DIE

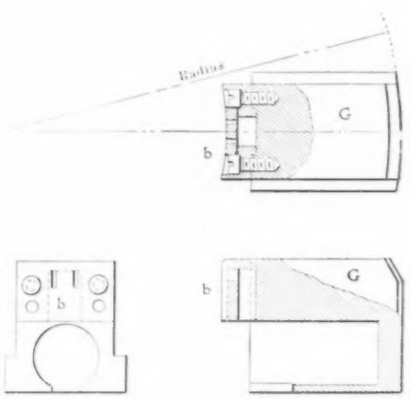


FIG. 4
Four Required, Tool Steel

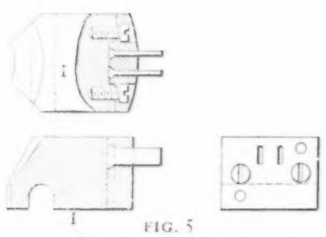


FIG. 5
Four Required, Tool Steel

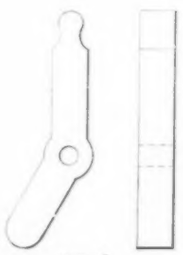


FIG. 6
Four Required, Tool Steel

THE PUNCHES AND DIES

which is shown in detail at Fig. 7. After the die performs its work the ring *F*, as the ram of the press rises with the punch holder *K*, and punches *e e e e* and *H*, is returned to its normal position by means of the four springs *f*, one of which is shown in Fig. 2. The outer jaws *G* are driven back by the springs *g* coming to a stop against the bevel of the ring *F*, the inner jaws *I* being brought to their normal position by the levers *h*, which are actuated by the conical-spring plunger *L*. The position of levers *h*, when the conical-spring plunger *L* is in its uppermost or normal position is shown by dotted lines. A detail of lever *h* is shown at Fig. 6; they fit the slots *i* of the stake *M*, Fig. 7, swinging on pins inserted through the holes *j*. At Fig. 8 is shown a detail of the die shoe, showing guide-pin holes, spring cavities for springs *f* to actuate the ring *F*, holes *K* for the punchings to fall through, gib-screw and dowel-pin holes, etc. This detail also shows the channels in which the outer jaws *G* slide.

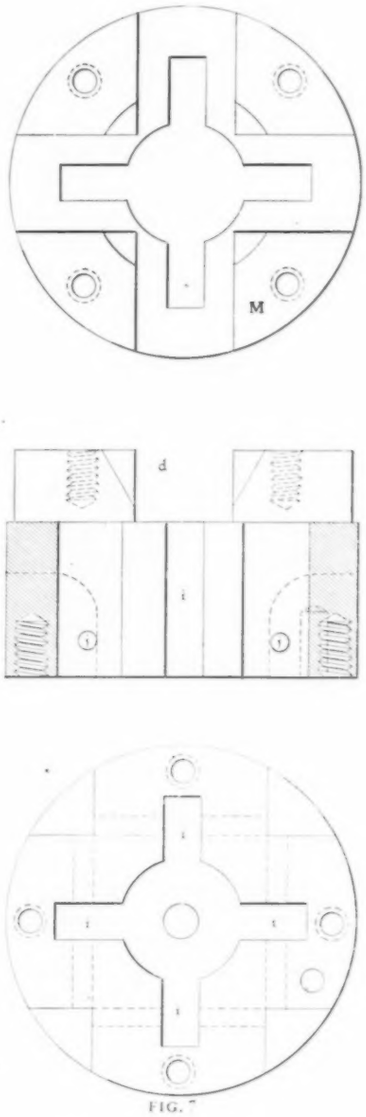


FIG. 7

THE TOOL-STEEL STAKE

The spring plunger *L* has a pilot, the end of which rests against the bottom of the inner jaws *I*, when they are in their normal position, and which also serves for the end of punch *H* to strike against and release the levers *h*, from the conical part of *L*, when driving the inner jaws *I* out, the object of the levers *h* being only to bring the jaws *I* back to their normal position.

In dies of this character it has been customary to make the outer jaws only work, the dies being set in a solid center stake with the result of a great deal of trouble in removing the work from the die on account of the bur, no matter how slight, holding fast in the dies, to say nothing of the slowness of placing the work in the dies. This difficulty has been entirely overcome in this tool, as the work can be dropped into position with the greatest ease and can be removed with equal facility. This die has been running for eight months and is a rapid producer.

It is, therefore, a most useful principle in connection with dies of this description, for rapidity of operation is all-essential, and is a principle which no doubt can be applied to a wide variety of work. I trust others will have as good success with it, as I have had.

Cleveland, O. R. J. KRUSE.

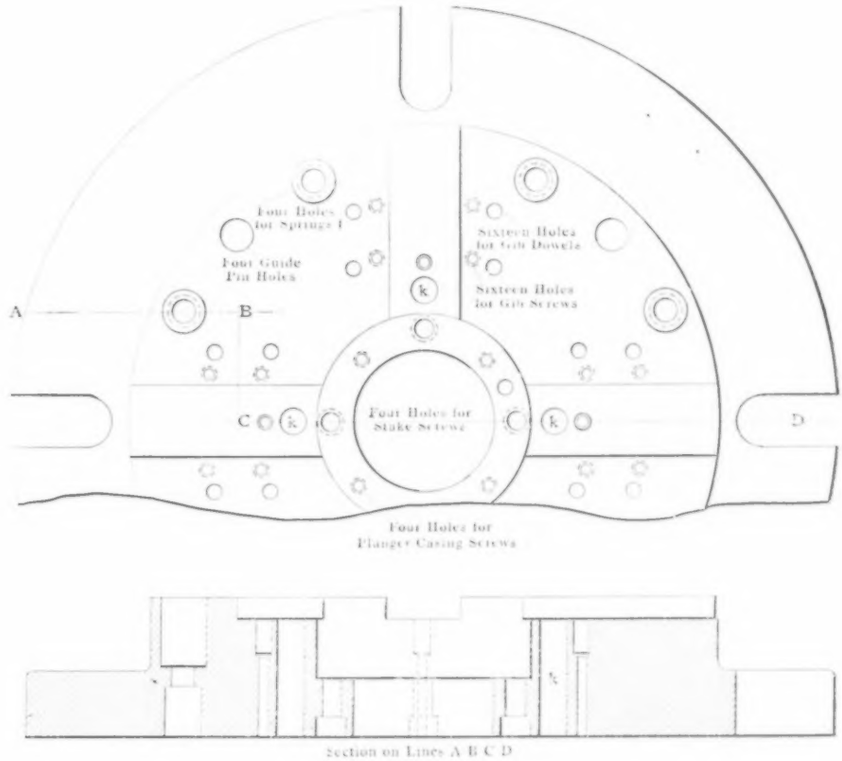


FIG. 8. DETAIL OF THE DIE SHOE

Backing-off Cutters in the Lathe

Having experienced some of the joys of trying to back off formed cutters and such tools in shops whose equipment did not include a relieving lathe, I know that a simple and efficient method of machine relieving on an ordinary lathe which does not require special tools and is highly accurate will be acceptable to say the least. The method consists in simply using the cross-feed on a lathe having a compound tool rest. The upper slide is set parallel with the lower slide, and must be graduated.

To back off, say, a ten-tooth cutter, the forward cross-feed is thrown in and by means of marks on the lathe head and observations of the micrometer dial on the bottom slide of the rest or otherwise, it is found just how many thousandths the feed causes the slide to travel in for one revolution of the spindle. Dividing this by ten, the number of teeth, gives us the forward travel per tooth. All that is necessary now is to revolve the spindle slowly by hand, one tooth at a time, and after each tooth is passed and the open space reached move back the upper slide the required amount to put the tool again in its original position. With proper care in the readings, and light cuts with sharp tools to prevent digging in, a good cutter can be made which can be ground repeatedly without changing its shape in the least or making one tooth do all the work.

This method may not be as new to others as it was to me, but it deserves to be better known for it will be a great help to men who are expected to turn out first-class tools with poor equipment and there are many such.

P. A. FREDERICKS.

Grand Rapids, Mich.

Making Accurate Screws in the Lathe

Recently while sojourning in Detroit, I had the pleasure of an interview with J. P. Lavigne, of the Lavigne Manufacturing Company. Mr. Lavigne was formerly of New Haven, Conn. While reminiscing over times, places and people in Connecticut, the subject of the micrometer which Mr. Lavigne used to manufacture, came up, and he explained how he produced the practically perfect screws which are necessary in good micrometers.

The simple ingenuity of the scheme so impressed me that I secured permission to write it up for the AMERICAN MACHINIST, where I believe it will be read of with interest by many mechanics, for it is doubtful if many would know how to proceed to cut a precision screw without a lead screw, and in this case a well known maker of precision screws had failed to furnish a screw which was considered satisfactory.

An ordinary make of 14-inch lathe was secured, and stripped of all its feed mechanism, both turning and screw-cutting, and a substantial cast-iron frame *a* bolted to the back end of the headstock, as shown in the accompanying freehand sketches. The back or inside of frame *a* was planed straight through lengthwise, and a slide *d* carefully fitted; on the face of this slide was fitted the lead bar *e*, which was attached at one end with a dowel bolt, and made adjustable at the other with an adjusting screw and clamping bolt, and set at an angle as shown.

On the front of frame *a* and at right angles to its axis, was planed a seat for the slide *b*, which was carefully fitted in place, secured with a plate gib, and attached to the carriage by the rod *c*. Attached to the slide *b* by a dowel stud, and nut washer, was the yoke shown in the detail at *g*, the fork of which fitted accurately on the lead bar *e*.

The lead bar was made as accurately as possible, three being made, and all scraped and lapped, until any two would show straight when placed together, which proved them all to be straight.

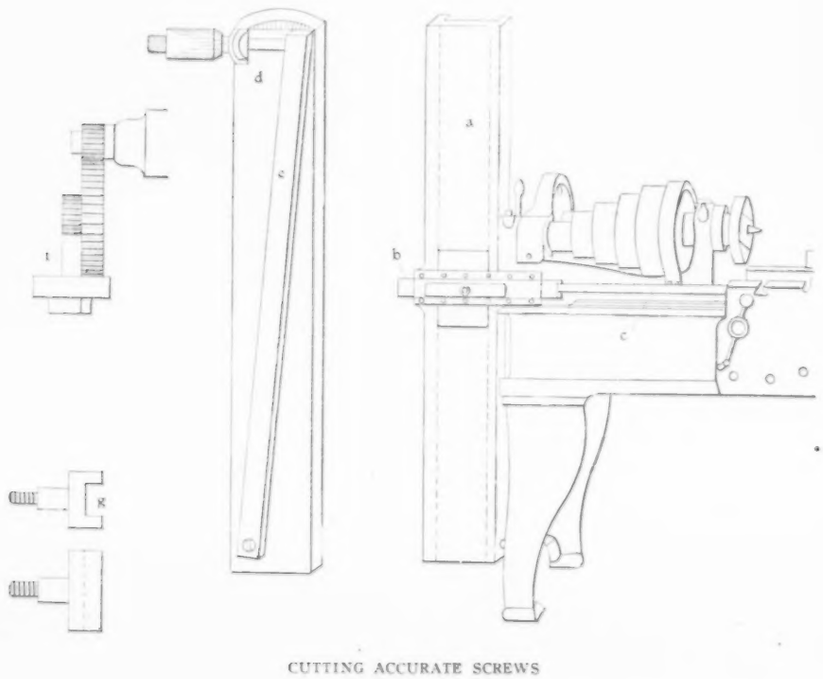
Firmly attached to the back of the slide *d* was the rack *f*, and connecting this with the lathe spindle was a train of gears as shown in detail sketch. These gears and rack were made by a firm of gear specialists, the specification calling for a tooth which represented complete turns of the worm in the dividing head, which assured an accurate gear, the same applying to the rack.

Now it is obvious that with this rig in position when the spindle was run forward or back the slide *d* moved up or down, the lead bar *e* moved the slide *b* laterally in or out, and the latter the lathe carriage, so that the relation of the spindle and carriage was the same as when cutting threads with a lead screw; and it is also obvious that if the lead bar was adjusted, to correct a screw say one thousandth in its total length, this thousandth would be accurately sub-divided into as many parts as there were threads on the screw.

Mr. Lavigne states that he submitted one of the screws cut with this rig, to a firm which has a world-wide reputation for accurate screws and screw gages, and their expert pronounced it a perfect screw within his ability to measure it.

This all happened some seventeen years ago, and may seem like pretty ancient history. I suppose the micrometer makers have a better way than this, and am sure whatever method they use would make a mighty interesting story.

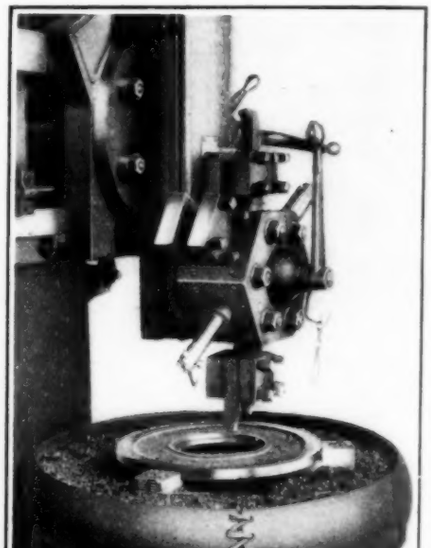
Detroit, Mich. THEODORE.



CUTTING ACCURATE SCREWS

A Chip Guard in the Boring Mill

At the works of the Brown-Lipe Gear Company in Syracuse, they use a number of vertical boring mills to finish nickel-steel forgings for their steering gears.



A CHIP GUARD

The boring mills are run at as high a speed as the tools will stand.

Formerly the chips were thrown by centrifugal force all over the place.

Some master-mind laced a short piece of old belting around one of the tables, cut half-round notches for the chuck key to enter the holes and started the machine. The chips fell to the face of the chuck and were retained by the belt.

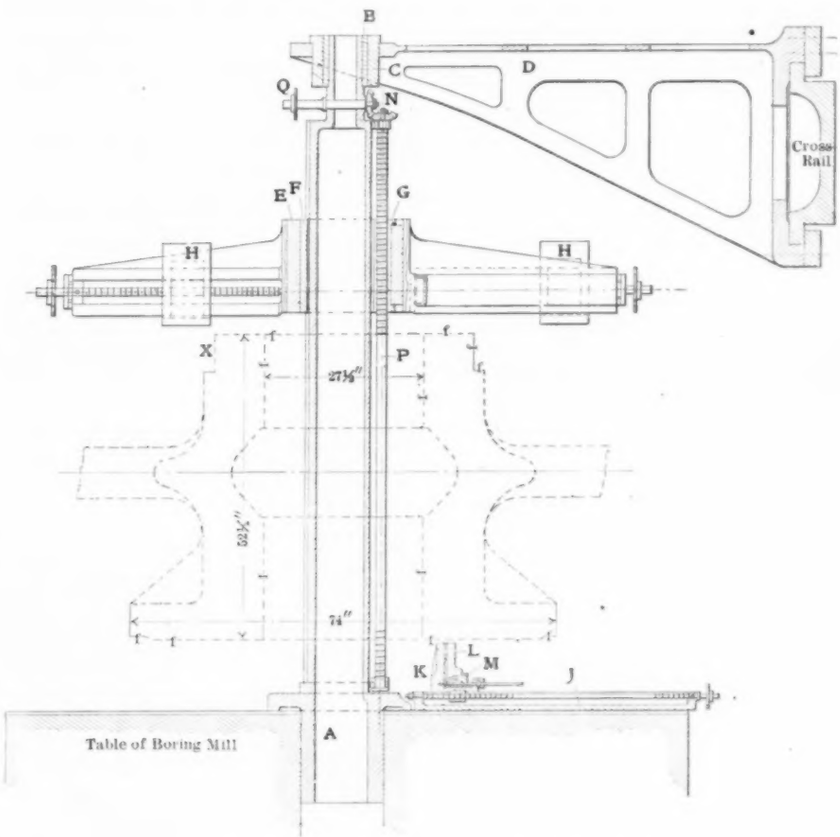
When necessary to clean, the belt is easily removed and the chuck is left clear for cleaning.

The first one made so proved its usefulness that all the other mills have been similarly equipped. E. A. DIXIE.

New York.

Rigging a Boring Mill to Machine a Large Fly-wheel

Scheming and ingenuity are sometimes necessary to adapt machine tools for work beyond their capacity. Such a situation existed when we wished to machine a large fly-wheel on a boring mill. The mill was one of those in which the frame slides away from the table so as to accommodate large pieces of work within its range. In this case, however, even when the frame was set back it was impossible to work near the center of the castings. In fact, there was a distance of nearly 80 inches between the cross-rail and the center of the table.



BORING MILL RIG FOR MACHINING A LARGE FLY-WHEEL

The hub of the fly-wheel is shown by dotted lines in the accompanying figure, and the surfaces to be finished are indicated in the usual way by the small letter *f*. It was necessary to develop a device which would machine both the top and bottom of the fly-wheel hub, as well as finish the bore.

Referring again to the figure, the device which we developed was arranged as follows: Into the hole in the boring mill table was fitted a cast-iron column *A* guided and held at the top by the arm *D* which was securely clamped to the cross-rail. A brass sleeve *B* and a cast-iron bushing *C* formed the upper bearing. A carriage support or bracket *E* was arranged to slide on this column guided by a key *F* and receiving its motion from the screw *P* in the nut *G*. This screw *P* is driven by miter-gears *M* and the star wheel *Q*. This comes in contact with a finger fixed on the frame *D*.

On the bracket *E* travel two carriages *H H* which hold the cutting tools. Their feed is from screws actuated by star wheels which can be seen one at either end of the bracket *E*.

The surface indicated by the letter *X* was finished by tools carried in tool posts on the carriages *H H*, the facing on the bottom was accomplished by using the device consisting of the guide *J* bolted to the boring mill table, the carriage *K* which slides on it and is driven by a screw and star wheel and the tool block *L* arranged to be regulated for hight by the conical wedge *M*. The boring was done with a boring head built something like the carriage bracket *E*, and carrying two tools.

With these special tools and devices the facing of the top and bottom was done at the same time, and while the hub was being bored the rim of the fly-wheel was turned with one of the regular heads of the boring mill.

Erie, Penn. P. FENAUX.

A Jig for Drilling Spanner Holes

Figs. 1 and 2 show a jig for drilling spanner holes in caps for loose pulleys. We use it for three or four different sizes. The collars *e* and *f* in Fig. 2 can be put on instead of the one that is on to fit the hole in center of the cap in the jig in Fig. 2. Fig. 1 shows the jig. Fig. 2 shows the cap held in the jig by the gripping handles *b* and *c*. The screw *d* holds the cap in its place while it is being drilled.

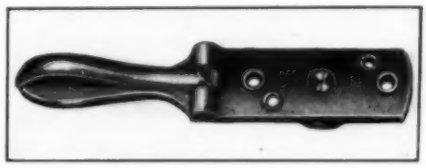


FIG. 1. THE JIG

JOHN E. ANDERSON.

Winchendon, Mass.

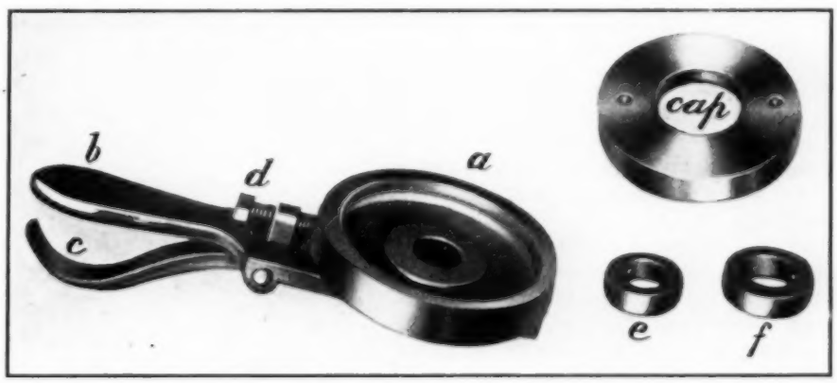


FIG. 2. THE JIG WITH CAP IN PLACE

The apparatus used in the manufacture of alcohol in Salvador is entirely of French make. The plants in this industry, of which there are 62, vary in cost from $3000 to $15,000 silver ($1224 to $6120 gold), according to capacity. The owners of plants, who were interviewed in this connection, could give no reason for their preference for French apparatus except that they had been accustomed to its use, and their attention had not been specially called to apparatus manufactured in any other country.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Brakes for Hoisting Engine

At page 779 is a description of the application of a fan brake to the drum of a hoisting engine for lowering stone from a mountain side by means of an incline; also an application of an air-compressing cylinder with receiver, the air in the receiver being used on the return trip to operate the hoisting engine. With each of these contrivances, as I understand it, a hoisting engine is used to pull the empty car up the incline. This problem of lowering mineral from a mountain side has been solved so often, so simply and so efficiently in the coal-mining field that one can hardly imagine an engineer using power to pull his empty cars up to the mine or quarry when so much power (that generated by the descending load) is going to waste.

The way we would arrange a plant like the one referred to would be to have a simple gravity incline with a drum at the top controlled by suitable band brakes, with two ropes leading from this drum and attached to the cars in such a way that as one car with the load descended the other, empty, would ascend. The two cars would pass at the middle of the plane; the loaded car would reach the "landing" at the bottom as the empty reached the top. The cars balance each other and the motive power is supplied by the weight of the net load in the descending car, and has to overcome all friction and other resistances. By proportioning the load to the incline in question it is possible to have an incline on which band brakes can easily and safely control the trip. In arranging the track for such an incline three rails are used above the passing, or middle part, four rails at the passing, and either two or three rails below the passing.

Numbers of such gravity planes are in operation in this section of the mining field (Tennessee) and one such plane for which I recently designed and installed a pair of multiple-groove endless-rope sheaves, or drums, is daily lowering 700 tons of coal over an incline 4200 feet long with a maximum grade of 54 per cent. This equipment has a capacity up to 2000 tons per day. Each trip, consisting of two cars, carries 20 tons of coal. Each empty car weighs 5 tons. The maximum static pull on the rope is 31,000 pounds; 1⅛-inch steel cable is used. The rear drum is 9 feet in diameter; the front drum 8 feet, with 10- and 9-inch shafts, respectively. Each drum has two brake rings, one on each side, for 10-inch wood-lined brake bands. Water is run inside the rim to carry away the generated heat.

On shorter planes, a plain cylindrical drum from 6 to 8 feet diameter by 6 to 10 feet long, or even longer, built up with wood lagging on cast-iron spiders with a steel shaft and suitable strap-iron or steel brake bands is used. This equipment is very simple, cheap and highly efficient.

In all cases of gravity planes gravity should do the work of the plane; no engine or other power will be required. Gravity planes, when properly designed, can be made to operate with grades as low as 6 to 8 per cent., depending on length.

The jobbing machinist did a very creditable mechanical job in rigging up his fan brake, and later his air-compressor cylinder, but it certainly would have saved the quarry owners money both in equipment and operation to have employed a competent engineer to solve their engineering problem.

Knoxville, Tenn. WILLIAM WHALEY.

Time Recorder for Machine Tools

The automatic indicating device illustrated and described on page 595, in use at the works of the Lodge & Shipley Machine Tool Company looks very nice, and no doubt has cost a good deal of thought to invent and money to install. Apparently some good results are obtained for it, but I would like to ask, is it of any *real* use in a machine shop?

Personally I doubt it for this reason: In a machine shop a machine tool need not be always producing when running. If a machine operator is inclined to waste time it would not be very much more difficult for him to do so with his machine running light than with it standing still. If so, what is to prevent a false record being made? Of course, it may be argued that the operator's foreman will see that that does not occur, but the foreman should just as easily see that the operator does not waste time whether the automatic indicator is installed or not, and, unless the device is intended as a check on the foreman, of what use is it?

I could see the use of such a device, say, on a weaving machine, which is automatically producing all the time it is running, but cannot see that it would be of as much use really in the average machine shop as would appear at first sight. I may be wrong, but that is my impression; if wrong, I should like to be corrected. I may say I was approached by a firm marketing a similar device some months ago. In the course of discussion the foregoing objection was mentioned, and, rightly or wrongly, they agreed with me and did not press its merits.

Glasgow, Scotland. H. A. DUDGEON.

Crosswise Holes Through Cylindrical Work

As Mr. Jehn, at page 661, has mildly taken me to task on this subject, I wish to say that the word "difficult" was used in a comparative sense, meaning that a hole crosswise through a round bar was more difficult to drill than one through a flat plate, the former requiring more mechanical skill to accomplish or else more apparatus, and in this I think Mr. Jehn will agree with me. It was my fault in not so stating the facts in the first place.

In regard to the V-center, that is a piece of apparatus that I never had any very great affection for. As ordinarily made in one rigid piece, if used in a lathe with a left-hand feed-screw in the tail spindle, and a slight amount of play in the spline (conditions frequently met with), there is a tendency of the work and tail spindle to twist just as the drill commences to come through, and this tendency is in just the direction to aggravate matters and cause the drill to dig in more, and perhaps break. Besides this, when the work tries to follow the drill in its rotation, and the V-center cannot do so, the work then has a tendency to climb up the sides of the V, and this makes matters still worse. This climbing tendency increases with an increase of the angle of the V, and with a decrease in its width of face. Nearly all the V-centers I have seen had too great an angle, and were probably made that way with the idea of covering a greater range of sizes. These faults are each small in themselves, but they all take effect in the same direction, and we get the sum of all of them in the net result. A V-center is a little less objectionable if mounted so it can swivel around the tail spindle as an axis, as that eliminates to a large extent the tendency of the drill to dig in when coming through.

But there is another fault with the V-center: Some of my work calls for a cross-hole rather large in proportion to the rod through which it is drilled, and in cases like this the drill cuts into the sides of the V, which puts it out of commission for drilling small holes near the

extreme ends of rods. This difficulty could be overcome by making the V of a smaller angle, but this in turn would either make the V longer and more awkward to use, or else limit it to a narrower range of sizes.

One reason for not using a milling machine for work of this nature is because with the ordinary size of this tool the mass of metal to be moved for feeding against a small drill is so great as to detract considerably from the sensitiveness of the touch, and it is difficult to tell when the drill is cutting freely. Another and more potent reason was that I had no milling machine.

In regard to doctoring a hole after it was drilled, Mr. Jehn will please note that the only facilities available on that particular occasion were a lathe with a flat drill plate in the tail spindle; no V-center, no milling machine, no jig, no appliances of a special nature, and I doubt if he could drill holes under those circumstances that would not occasionally be improved by a little doctoring.

Brooklyn, N. Y. WALTER GRIBBEN.

Hardening Forming Cutters—Springs

In reading, at page 619, the criticism of Mr. Markham's article, I am reminded of the trouble I had when toolmaking back in the nineties.

We were running a lot of nut machines and using forming cutters similar to that shown in Fig. 1. The nuts manufactured were what was known to the trade as "semi-finished," that is, a thin shoulder

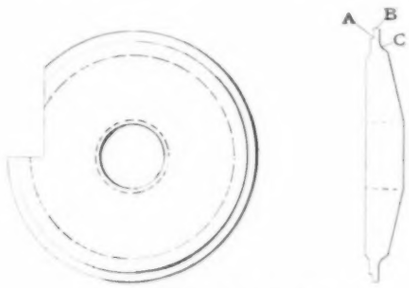


FIG. 1. NUT-FORMING TOOL

was turned on the back of the nut, the front of the nut having the corners of the hexagon chamfered.

I was expected to make these forming tools and harden them so that they would stand up to the work. The "hardening plant" consisted of a portable forge set up in one corner of the shop, a bucket of fish oil, a barrel of water, a few pieces of boiler plate, a small box of coal and a couple of pairs of tongs.

The cut-off part of the tool was in no case, even for the largest nuts, over ⅛ inch thick and in most of them it was 1/32. As I had had very little experience in hardening and none at all on forming tools, I made up a half dozen and took them to the forge and hardened them in water as carefully as I could. On account of the middle being thick in proportion to the rest of the cutter the heating was done very slowly. As I hardened each one I laid it carefully on the window ledge.

It was summer, the window was up, and when I had finished hardening the last one, two of the cutters had lost the entire rim, breaking at *A*, and a third snapped off in my hand with force enough to draw blood. The other three, through

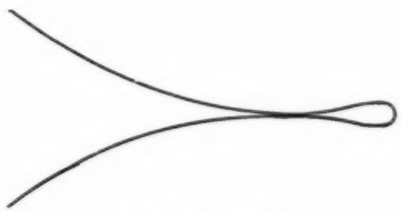


FIG. 2. A SPRING

sheer good luck held together until I could polish and draw them on a hot piece of boiler plate.

They worked all right and I thought I had discovered the cause and my troubles were over. But they weren't. I found that the draft from an open window wasn't the only thing that would cause these cutters to snap off at *A*. I tried water and I tried oil, but would lose about two out of every six and sometimes was lucky to save two out of the six.

The boss couldn't help me any as he had had even worse luck than I had and he was satisfied if I could make cutters enough to keep the machines running.

Finally, I decided that I cooled my tools too much and thus set up an unnecessary strain, so I arranged my forge fire so that I could heat up a piece of boiler plate at the same time, I was heating my cutter for hardening. As soon as I had the cutter hot enough (I used an iron hook, instead of tongs to handle the cutter), I plunged it straight down into the middle of the barrel of water, working it up and down, but being careful not to bring it above the surface, until it stopped "singing," then I plunged my hand down beside it and as soon as I could hold it, pulled it out and ran to the felt polishing wheel and lightly polished the rim *B*, the hollow *C* and a streak across the sides, then as quickly as possible I put it on the hot boiler plate and drew it slowly and evenly to a nice straw and I had broken my last nut tool, for I never had another one snap off afterward.

For some time I was bothered a little in drawing on the boiler plate by smoke from the forge discoloring the polished spots, but one day I mentioned this trouble to an old Brown & Sharpe toolmaker and he told me to rub a little clear lard oil on the polished places before putting the cutter on the drawing plate, which I did and after that I always kept an old cup with some lard oil in it handy. Too much oil should not be used; just a little should be rubbed on with a reasonably clean finger. However, with the tempering baths now in use, this little kink is of little benefit to the shop hardener, though for an occasional job it is well worth remembering.

In looking over Entropy's article at page 620, I wondered why he didn't make his springs like Fig. 2 and save the trouble of riveting. It is a principle used in making most of the gun-lock springs and as will readily be seen, the strain does not come all on the bend as it does in his first illustration.

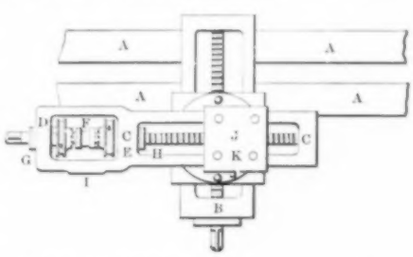
The bend may be made considerably sharper than the sketch, Fig. 2, shows and still give good results. In fact in many cases it is drawn and made almost flat.

Decatur, Ill. ETHAN VIALL.

Turning Taper Plugs

The British plugging lathe described by Mr. Carrell, on page 392, reminds me of a machine, or rather an attachment, used for the same purpose, which I designed some years ago. It has turned thousands of brass plugs to our satisfaction, and in fact we find it profitable to keep two of these attachments fully employed. They cost us under £5 ($25) each, and are used on a common brass-finisher's hand lathe.

Referring to the illustration *A* shows the lathe bed or shears and *B* an ordinary slide rest cross-slide attached by a central bolt and clamp to the lathe bed; *C* is the only special casting required and takes the place of the ordinary top slide or compound rest. It has a bracket or box-shaped end, which surrounds two flanged



LATHE ATTACHMENT FOR TURNING TAPER PLUGS

steel pulleys *D* and *E*. These two pulleys revolve in opposite directions; each has a clutch face milled on the hub, which engages with the sliding clutch *F*. There are two lock nuts *G* and *H* for securing the pulleys in position and prevent them from moving endwise, for they run loose on the feed screw. The handle for operating is not shown. The ordinary English pattern tool holder with four studs is used (see *J*). At *K* is a small stud screwed into *J* which acts on a trip rod (not shown) and operates the clutch *F* when the tool has reached the end of the work it is operating on. The trip rod is simply a straight round bar 5/16 inch in

diameter and carries two adjustable dogs. It is coupled up to the clutch handle at one end, and supported in a small bracket at the other.

It will be seen that the top slide *C* can be swiveled as an ordinary compound-slide rest to suit the requisite taper. The clutch *F* is manipulated by the left hand of the operator. When the clutch is in the central or neutral position, as shown, the feed screw is, of course, out of gear, and can be operated in the ordinary way by a handle for turning into corners or for cutting off.

Manchester, England. B. R. ASHE.

After I Have Served My Apprenticeship What Shall I Do?

In J. G. Dornbirer's article on page 597 there are one or two statements that I do not exactly agree with, although I believe the majority of manufacturers and foremen do not appreciate the value of the apprentice after he has served his time.

As a rule an apprentice, during his time thinks very little of the size of his pay. His first aim is to master the trade and become a first class mechanic, so that he can command the highest rate of wages for his line of work. He doesn't expect anything but apprentice's wages and only asks for journeyman's wages after he is out of his time. If he is worth journeyman's wages to the other shop, why isn't he worth the same to the old shop?

Mr. Dornbirer makes the statement that the shop in which you have served your honorable apprenticeship has more for you to learn. Yes; the old shop has many things the apprentice just out of his time can learn, and is anxious to learn. But does the old shop give him the opportunity to learn any of these things, even if he should stay there 10 years or more? It is seldom that the old shop does any such thing. The reason "he goes out and burns away several years of his life in quest of something he might easily have learned in the old shop" is because the old shop will not give him the opportunity to learn those things. The new shop does. Can you blame him for doing that very thing? Consult all the first-class mechanics you know and see if they didn't leave the "old shop" in search of more ideas.

I believe it is best for any young man, after serving his time, to go to another firm for the purpose of learning their ways.

Right here I want to say something about "moving around for experience" as it is called. I have heard several say "the best way to learn a trade or get experience is not to stay in one shop more than four or six months." They claim in that way you will soon be experienced enough to hold down a good job as a journeyman. Possibly that might work in an extreme case but I am sure it is very poor policy.

Another statement Mr. Dornbirer makes is, "Did anybody ever suggest to you that the boss needed an intelligent young assistant and eventually a successor?" Yes, such a time will come sooner or later. When the boss needs an assistant or successor where does he get him? How many foremen or superintendents served their apprenticeship with the firm for whom they are now working? Doesn't the boss most always go outside for his assistant and isn't his successor appointed from outside? The apprentice's chances of becoming an assistant foreman or foreman are very slim in the shop where he has served his apprenticeship. That is as it should be. No man should be made a foreman in the shop where he has served his apprenticeship, at least not until he has spent a few years in one or two other shops. I think the better foremen are those that have worked in three or four shops. They are broader minded than the fellow of one shop. The older men don't take kindly to a boss who a few years ago was a "cub" among them.

After the apprentice has served his apprenticeship, what shall he do? Seek for the best he can get; if the old shop gives it to him, stay; if not go eleswhere.

Elyria, O. A. B. HOWK.

Expanding Arbors

Having noticed Mr. Brown's practical letter on "Expanding Arbors" at page 393 and noting their defects in construction, I thought the following might interest your readers:

A short time ago I had charge of two Dean Smith and Grace turret lathes, which were employed for turning engine eccentrics of both small and large sizes, the diameters varying from 4 to 24 inches and the throw from ½ to 6 inches. I designed the arbor as shown in Figs. 1, 2 and 3 which was very strong, convenient to handle and very effective in holding the eccentrics true and firmly in position. I was at Robey & Company, Ltd., Lincoln, England, when I introduced them and they are still in use and doing accurate work for high-class steam engines.

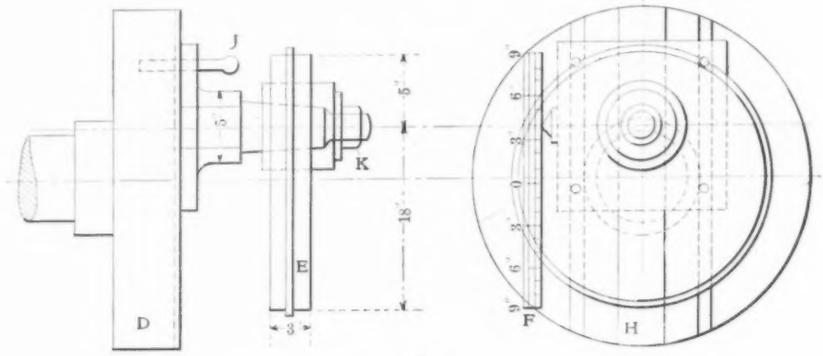


FIG. 1

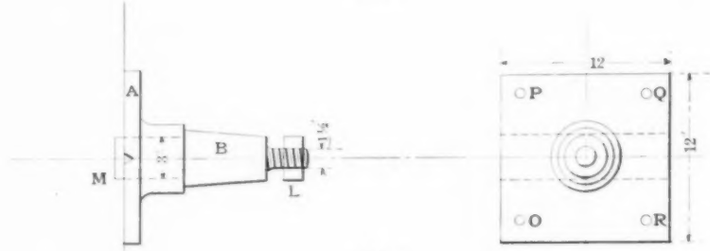


FIG. 2

FIG. 3

AN EXPANDING ARBOR

Fig. 1 shows the arbor attached to lathe face-plate *D* with an eccentric *E* on it complete and in correct position when finished. Fig. 2 shows the arbor, *A* is a square cast-iron plate with mild steel-taper arbor *B*, driven tight in and keyed into the plate *A*. The plate *A* is provided with a projecting strip *M* which fits into

a corresponding recess planed in the lathe face-plate straight across its center as shown in Fig. 1, at *H*. Fig. 3 is a bushing turned true to fit the required bore of the eccentric and bored taper 1 in 12 to fit the arbor *B*. This bushing *C* is cut right through at *N*, and the other five slots nearly through to allow it to expand.

The lathe face-plate *D* is provided with a recess, cut centrally to receive the projecting strip *M* on the arbor, also with two T-slots for four bolts, which hold the arbor as shown in the plan, Fig. 2, and marked *O P Q R*. A steel rule is also provided which is attached to the face-plate having zero mark in the center position for showing the travels or throws of the eccentrics.

The working of this arbor is very simple First, the arbor is set at the required throw as indicated by the steel rule *F* on the face-plate and the steady pin *J* is inserted into the hole to prevent moving and then the four bolts *O P Q R* are tightened, the eccentric is set true on the arbor, and the bushing *C* is forced in by the nut and washer *K L*. The eccentric is then turned to receive the eccentric strap. The arbor *A B* is then slid across into central position which is also located by the steady pin *J*, and the sides are then turned and polished and if the eccentric has a boss on it will also be turned in this position.

It will be noticed that the heavy side of the eccentric will just balance the weight of the arbor and effects steady running in the lathe during grinding in and polishing operations. By the above means the eccentric is held perfectly true and secure and will carry very heavy cuts. It is convenient for both putting on and taking the eccentric *E* off when finished and effects a saving of 50 per cent. over the old way of driving a heavy mandrel in with heavy lead hammers or an arbor press, and minimizes the risk of cracking the eccentric.

H. Maplethorpe.

West Bromwich, England.

Using the Advertising Section

Paul W. Abbott's article on page 825 voiced my sentiments in regard to reading advertisements; I fully agree with him as to its value. I derive a great deal of benefit each week from my copy of the Amecican Machinist in carefully reading the advertising pages.

The manufacturer or advertiser has a story to tell, or an article to publish. This story, in order to accomplish its results, must be beneficial to the reader as well as the advertiser. To be beneficial to the reader his story must contain as few words as are consistent with its purpose; this allows the reader to quickly grasp and easily retain the full text, and helps to make the reading of this section not only an educational feature but a pleasure.

Illustrations are one of the strongest features of the advertisements. It is a well known fact that a poor illustration, no matter how well the body may be written, will kill the advertisement. I find very little trouble in becoming almost as familiar with some of the important features of a machine, from these illustrations, as could be obtained from the actual machines themselves.

If a mechanic is interested in his trade and desires advancement he must learn. One branch of this is familiarity with the construction of and names of builders of modern machine tools. I do not know of a better way to acquire this than a careful examination of the advertising section of a good mechanical paper.

Laying aside any points from the advertisers' side, the illustrations of the class of work that has been done on certain machines should particularly appeal to him. The illustrations are generally supplemented with full text explanations of the time consumed and sometimes the process of operation.

Providence, R. I. O. James.

Toolmaking without Drawings

At page 749, Samuel Taylor has an article on toolmaking without drawings as conducted in two of the largest manufacturing plants in the country. From this statement we cannot infer the size of the tool-room force, or the kind of work to be done. However, I will give some of my experiences in this direction, on tools for typewriter and adding-machine parts.

In one manufacturing plant, employing 20 to 25 toolmakers, the practice formerly was to give out blueprints for everything except small tools. The designs were widely different, the only uniformity being shown in fastenings, jig locks, etc. The tools were drawn up on cream paper and every screw, bushing and insignificant pin detailed. They were then traced by a beginner. The drawings were seldom checked, and some of the fixtures produced were weird and wonderful, their chief use being to enhance the value of the scrap heap.

A new draftsman took charge, and for several months tools were made without drawings, according to the toolmaker's individual design. Mistakes were frequent, and this system showed merely a change in methods without any improvement.

A change in the management caused the installation of the present tool-drafting department. Instead of two or three draftsmen and a tracer, this consists of the tool-room foreman (as chief designer) and a draftsman who has had several years' experience at the bench. At first, the designs, emanating from the brain of the tool foreman, were drawn up on tough brown paper, re-checked as to general principles of construction and shellacked. The idea worked fine, but the shellacked drawings were bulky in filing, usually came back very dirty, when on the bench were not accessible to the draftsman for reference, and in the case of cast-iron parts, a separate paper tracing had to be made for the patternmaker.

To overcome these objections, the drawings are now laid out in pencil on a tough tracing paper and inked in. This method is just as quick as the previous one, because on die drawings, such standard parts as stripper plates, screws and springs can be traced from another drawing. Erasures are easily made, and the drawings take up but little room in the filing cabinet. After the tool is finished, the returned blueprint is destroyed. In case of repairs or alterations another can be quickly made. A drawing is rarely detailed, unless it is an intricate jig or fixture. In order to avoid confusion in reading drawings, simple parts are shown in only one or two views. Punch and die drawings give no dimensions of the punch or die opening, but a note is made thus:

"MAKE PUNCH TO SIZE
MAKE DIE TO DIA. OF PUNCH + 0.0038"

A small blueprint of the part furnishes the toolmaker with all necessary information.

The supervision which was formerly required to explain a design to the toolmaker and correct mistakes, is now used in keeping the machines going, and the work moving without friction. From the superintendent's standpoint, the economy of this system cannot be much improved upon, and a book on the shelves of the tool stock room will reveal the uniformity of the design.

Toolmakers may be fairly well educated and experienced in design, but where is the man who can estimate all the clearances on a drill jig for 10 to 40 holes from several sides, or figure all straight-line dimensions from the angles shown on his part drawing? In designing a jig he will mark up several sheets of scratch paper, "just to get a rough layout, to see how the thing will look." After the jig is half completed, something is forgotten and "we'll have to patch a piece on here." If the machine work is done by a shaper hand, he will have to furnish a freehand sketch of the individual pieces to illustrate his ideas. Isn't this drawing? Why not put it under one man and concentrate the errors?"

In any well organized shop, the man in charge would not permit the foolish instructions mentioned in the previous article. Neither would a shop-experienced draftsman be guilty of them. The draftsman will remain an essential factor in the tool-designing end of any progressive business as long as he is progressive, and the cost of the tools will prove the superiority of a rational system over the cut-and-try method.

Chicago, Ill. L. P. Sittig.

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A Uniform Cost System

The report on a uniform cost system presented to the recent convention of the National Machine Tool Builders Association by its cost committee is a positive proof of the wisdom of the action of the convention of a year ago in electing that committee. Throughout the discussion as to the advisability of appointing a committee for this purpose ran the thought that its work at best would be most general in character, and would not be productive of results which could be applied throughout the machine-tool building industry. This fear seems to have been groundless; for while the system as outlined in the report is general in character and leaves many details to be determined from a careful consideration of specific conditions, still definite recommendations are made in every case and errors, if any, are confined to the conservative side of the problem—that is, toward increasing profits, not decreasing them—and many of the most subtle elements of shop costs are set forth in such a way that they cannot be overlooked.

The reason for establishing this committee and rendering this report is clearly summed up in this quotation: "The whole idea of the present report, which represents a simple method of system began with the fact that machine-tool manufacturers making similar and competitive machine tools discovered among themselves ruinous and unprofitable competition based presumably on actual costs. Comparisons soon showed, however, that even where there were fair cost-system methods important and appreciably large elements were treated by different manufacturers in different ways. It became apparent then that for the good of all it was desirable that machine-tool builders should have a uniform cost system in which the various elements of cost should be handled alike by all, even if not handled in an entirely scientific manner." Clearly, an excellent argument for standardization!

While material and labor costs are easily obtained and their proper distribution readily recognized, there are other elements of factory costs which are more elusive, but which should be carefully ascertained and properly distributed in order to surround a business with conservative safeguards. Some of these elements of cost, which are often unheeded but which should be added in when figuring total costs, are: A small per cent. added to material cost for obsolete castings and that waste which goes on undetected; a proper depreciation on machinery and buildings; a fair interest on the investment; a proper charge into expenses for depreciation on patterns, jigs, fixtures, drawings and the like and a proper charge into expense for repairs made without charge, small tools, machinery foundations, bad debts and the like. To answer the arguments that some of these elements are an unnecessary refinement in cost determination, we quote: "In the long run it has been found that these safeguards are not foolish or ultra-conservative but meet actual losses that are unexpected but nevertheless sure. When, under these conditions, a manufacturer figures a profit on his machine tool it is a real profit, and he is able to keep up his plant in increasingly better condition.

"The wise manufacturer should desire not to show his costs as low as possible, but to show them at a high enough figure to make him perfectly safe in all contingencies in using this cost as a basis for selling price, and only reduce his cost by actual economy."

In view of the fact that so much has been written and spoken concerning factory systems from a restricted standpoint or from a view point embracing only the details of a limited set of conditions, it is pleasing to read this carefully stated definition of the elements of a machine shop cost.

"(1) Material. By material is meant only that material which becomes a part of the finished product.

"(2) Productive Labor. By productive labor is meant only that labor which can be rightly charged into the cost of some order number representing the construction of a machine, or part, or repair that is to be sold.

"(3) Factory Expense. Factory expense covers that multitude of charges which are necessary to maintain productive labor actively in the operation of manufacture, including such items as non-productive labor, small tools, etc., necessary to do the work, a fair charge for the wearing out of machine tools, patterns, jigs and fixtures, as depreciation, etc.

"(4) Selling Expense. Selling expense includes all money spent for disposing of the product."

The material and productive labor cost-system methods are worked up from well tried methods and present nothing that is new, with the exception of the important point that there are means for *proving* each account through bookkeeping.

Naturally the expense account is the debatable ground of any such system. In treating of this account, the report distinctly states that many of its recommendations are not scientific but are a compromise between a wide variation of opinions, and in every case are conservative, thus tending toward a higher profit than might be considered reasonable, rather than a lower one. It has been well remembered that the report is an attempt to get a standard method and that the simplest and easiest-used method stood the largest chance of general acceptance. The much-mooted question of depreciation is treated by a number of clear-cut recommendations which we will quote although in a somewhat disjoined manner.

"This (charging off pattern cost of

new patterns) really amounts to a two years' depreciation of all new patterns and this would seem a fair and conservative method but should apply only to patterns of a new design, all other costs being charged to expense at once.

"It may be said right here that the putting of patterns, jigs, fixtures and small tools into expense does not in any way destroy their real value as assets and they can be carried still on the books at any figure desired provided a depreciation account for them exists in whatever amount has been charged to expense at any particular time.

"Many will urge that such patterns should properly be charged against the particular machine and unquestionably on special machines this should be the case, but on standard machines it is impossible to prognosticate the demand and to charge this cost against the first few orders would be prohibitive.

"The manufacturer who charges all his pattern cost at once into his costs is making no mistake. He is simply making himself more safe.

"The cost of jigs and fixtures, when one of repair and change, should unquestionably be charged off into expense as it occurs. When it is the cost of a new and complete set the situation may be best handled as indicated in the pattern cost; namely, kept separate and proportioned over a number of months, say 24 as a conservative time. But still in the matter of these jigs and fixtures it is not an unwise course to charge them off at once.

"Good business reasoning and proved practice, therefore, leads to the consideration of a depreciation as a legitimate expense charge as a legitimate and conservative element of cost; but how much shall this depreciation be?

"Here is a much-disputed question. At best, however, this can be nothing but an average. Many attempts have been made to tackle this question. Everybody gets a different solution. It is advised that 10 per cent. a year on machinery is a fair, conservative estimate and in the case of buildings 5 per cent. is advised on frame and 3 per cent. on brick buildings.

"Depreciation on machinery should include all machinery that is kept on the books as an asset, as power plants, motors, shaftings, pulleys, etc.

"It should be a flat amount of 10 per cent. a year on total value so as to wipe out the value in 10 years, and not a per cent. on a decreasing value. It must be remembered that the standards advised are ones that should not be gone below."

One of the most unseen of all the elements of machine-shop expense is that of interest on investment. It is very seldom that this is taken into proper consideration as an element of factory expense. It, however, has a very real and reasonable basis for consideration as an expense item, for a manufacturer is entitled to the same profit on his invested capital as he would get if this same amount of money was invested in good securities. This item is treated at some length in the report and the recommendation which is made in regard to it states:

"A safe way of taking it is to put it in the cost."

Department expense is advised, although there are many places where it is considered as an unnecessary refinement and not worth the cost of obtaining. But the careful way in which the forms and details of the expense analysis records are worked out undoubtedly takes all the force out of such an argument. General items, as power, depreciation, taxes, insurance, interest on the investment and the like, are proportioned among the departments on a percentage basis, but a consideration of the report fails to show how these percentages are determined upon.

The various expense-analyses forms that are presented are worked out to give a monthly showing of expense, thus there is no necessity of using last year's expense for this year's production. The expense for each month is accurately known and immediate steps can be taken to investigate and correct if there are unnecessary or undesirable fluctuations. This is clearly as it should be.

In connection with the selling expense, it is worth while to notice that in figuring the cost of a machine tool the selling expense per cent. is taken on the sales price, not on the factory cost price.

We are at all times heartily in favor of sane standardization in whatever field it may be brought about and from that standpoint this report and the idea behind the report are especially commendable. Only through trial can its merits and defects, if any, be really brought out. It is a step in the direction of standardization of general business methods and the mechanism of business intercourse. It is in a field in which little has been done to establish uniformity, but is one where the beneficial results of uniformity will be tremendous.

New Publications

PRACTICAL STEAM AND HOT-WATER HEATING AND VENTILATING. By Alfred G. King. 402 6x9-in. pages, with 304 illustrations. The Norman W. Henley Publishing Company, New York. Price, $3.

The author of this volume has endeavored to prepare a book which should be within the comprehension of the average steamfitter and, so far as possible, devoid of technicalities. It covers the most recent developments in this subject, including the vacuum system and the modern methods of temperature regulation and control. We cannot but think that the author has said too much in disparagement of the hot-air furnace, which under proper conditions we regard as a far more satisfactory method of heating dwellings than steam. This, of course, is not said in disparagement of the book, which relates almost exclusively to steam and hot-water heating, in which field it will be found a useful guide to the steam and hot-water fitter.

MACHINE DESIGN, CONSTRUCTION AND DRAWING. By Henry J. Spooner. 691 5½x6½-inch pages, with over 1400 illustrations. Longmans, Green & Company, London and New York. Price, $3.50.

The time is undoubtedly ripe for a new manual of machine design, and the present author is obviously well fitted to prepare such a book. It is somewhat of the nature of Unwin's elements of machine design, but less analytical, and pays a largely increased attention to machine elements and details. It contains probably more simple formulas for proportioning machine parts than have ever been collected between covers before, every page giving evidence of the most painstaking care in collecting and sifting information of this kind. To the young engineer, especially who is without that instinctive judgment of dimensions which cannot be calculated by analytical methods, the book will be found to be a mine of information.

Personal *

F. J. Smith, president and general manager of the S. W. Card Manufacturing Company, returned recently from a three months' trip to Europe.

G. O. Gridley, of the Windsor Machine Company, Windsor, Vt., sailed for Europe June 11, and will make an extended business trip of two months.

Edwin D. Dreyfus, formerly employed with the Allis-Chalmers organization, has recently associated himself with E. W. Deane & Co., Grand Rapids, Mich.

Judson Lattin, who has been acting as mechanical superintendent of the Deering works of the International Harvester Company, has recently become superintendent of the Akron plant.

John MacGregor, formerly superintendent of the Pope Manufacturing Company, Westfield, Mass., has been appointed president and general manager of the Hampden Machine Screw Co., Springfield, Mass.

Frederick Lane, formerly with the Crosby Steam Gage and Valve Company and more recently employed by Wm. B. Merrill & Co., has become superintendent of Jenkins Brothers, Ltd., Montreal, Can.

Dr. Charles H. Benjamin, dean of Schools of Engineering, Purdue University, and known to our readers as a contributor to our columns, received the honorary degree of doctor of engineering at the recent commencement exercises of the Case School of Applied Science, where he was professor of mechanical engineering previous to his present call last August.

*Items for this column are solicited.

New Tools and Machine Shop Appliances

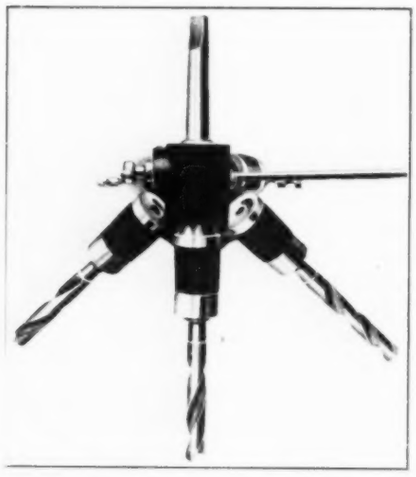
Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

A Turret Drilling Attachment for Drill Press or Lathe

This attachment is to be used either in the drill press, or lathe spindle, and allows any one of five different drills or other tools to be used at will. Only the drill in line with the spindle is in operation, so that there is no danger of injury to men or work from any of the other tools.

The body of the turret is of gray iron, the driving spindle of steel, with a projection or dowel in the center, so as to bring the auxiliary drill spindles into exact alinement when they are swung into position. A driving pin in the end of the main spindle engages in a milled slot, which can be seen in the end of each auxiliary spindle and drives both together as though they were one piece. The spindles are engaged or disengaged by an eccentric, operated by a small lever which can be handled by the thumb and finger. This permits very rapid changing from one spindle to the other, and without stopping the machine, so that considerable time can be saved where tools of several sizes



TURRET DRILLING ATTACHMENT

are required on one job. The work itself remains in one position during all the operations.

The attachment is made in one size only, and weighs 19 pounds. It will carry drills from 1/8 to 7/8 inch in diameter, the socket being made to fit a No. 2 Morse taper. It is being put on the market by the Patterson Tool and Supply Company, Dayton, O.

An Overload Detector for Cranes

The Denison overload detector illustrated herewith is designed for use on cranes to warn the operator when the crane attempts to lift a load too heavy for

OVERLOAD DETECTOR FOR CRANES

its capacity. It is automatic, instantaneous, and always ready for action. The moment the rated capacity of the overload detector is exceeded, a gong rings continuously, notifying the operator that the crane is attempting to lift an excessive and dangerous weight. This is accomplished by heavy springs within the apparatus which allow electrical contact to be made when the load for which it is designed is exceeded. The bed and battery are all part of the apparatus. This contact can be adjusted to compensate for any variation in the springs. Its weight varies from 140 to 300 pounds, depending on the size.

It may be used instead of an overhauling ball on cranes with fixed jibs, while on those with rising and falling jibs it may be secured to the tension rods. It is not affected by weather conditions, and tends to prevent accidents and possible loss of life.

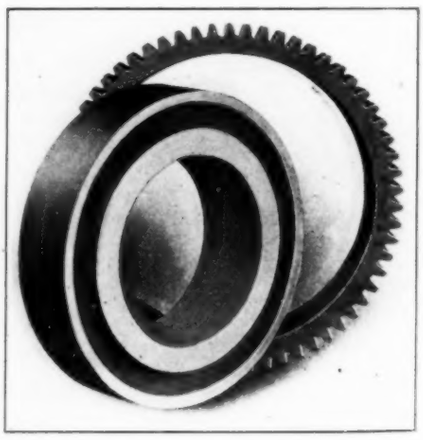
The detector is supplied in sizes from 2 to 15 tons by the Weston Engineering Company, 39 Wall street, New York city.

A Larger Screw-driving Machine

The Reynolds Machine Company, Rock Island, Ill., whose different types of screw-driving machines have been illustrated at various times, have brought out a larger size that handles screws up to 3½ inches long and No. 18 gage. This retains the automatic feed and other desirable features of the smaller machines but handles larger work such as in furniture making.

Gear with Removable Rim

In order to reduce the cost of renewal the R. D. Nuttall Company, Pittsburg, Penn., has been experimenting with gears having removable rims as shown and severe tests prove that these stand up in good service. The rim is made of a special grade of rolled steel of high tensile strength and is shrunk on a cast-steel center so that the two members be-

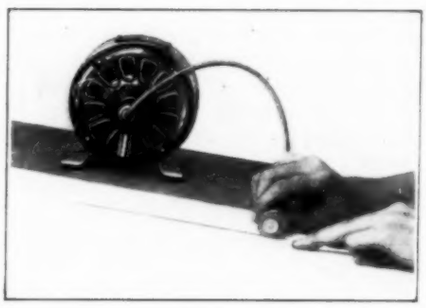


GEAR WITH REMOVABLE RIM

come practically one piece. When the gear teeth wear so that ordinarily a new gear would be required, the rim can be easily removed and a new one put in place at a much less expense than the renewal of the entire gear. Although this was designed particularly for heavy haulage trolley service, it can be applied to any other work and gears of this kind can be supplied up to 10 feet in diameter.

Motor-driven Eraser

Perhaps the latest application of the Coates flexible shaft and a Westinghouse motor is shown in the accompanying en-



MOTOR-DRIVEN ERASER

graving, where they are being used to drive a rotary eraser for making alterations on tracings in the drawing-room. Ordinarily it requires extreme care to erase a line from a tracing so as to make it very difficult to detect, but it requires a very light and fast motion and few have the time or patience to do this, and the usual result is that too much pressure is put on the eraser which does not make a good job. In this case, either a direct or alternating current motor of from 1/12 to 1/8 horse-power is attached to the eraser as shown and with the high speed obtained in this way, only a very light pressure is required to completely remove the line without injury to the cloth. This complete outfit is supplied by the Coates Clipper Manufacturing Company, Worcester, Mass.

A New Friction Clutch

The designers of this clutch have discarded toggle joints and secure the necessary friction by the use of three equally distributed screws, which are operated by spiral gears. Beginning with the hub 1, which is keyed to the shaft and which carries flange 2, there is friction plate 3 which is threaded for the three screws (two in the smaller sizes), one being shown by 8, so that the whole plate acts as a nut. The hub plate carries the three screws with their spiral gears 7 and ball-thrust bearings, together with friction plate 3, also keyed to shaft, so that these revolve at all times. The other member of the clutch consists of a long hub 6, which is carried up into a bell-mouthed pulley and carries a steel ring 4 at its outer end. This ring contains a number of gray fiber blocks 5, against which the friction plate 3 acts, and by clamping these between plates 2 and 3 the friction blocks, the ring which holds them, and the hub 9 are made to revolve with the shaft.

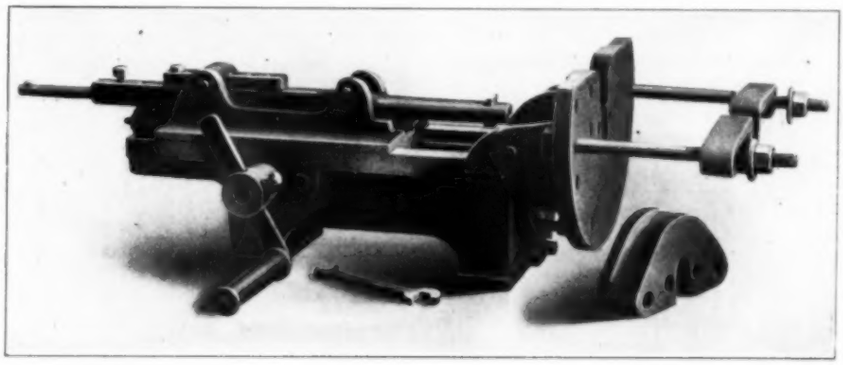
The spool 9 carries three racks which have angular teeth so as to mesh with the spiral gears on the end of the screws, and any movement in and out of these racks turns each screw and draws the friction plate against the block, or releases them if they are already engaged.

The spiral gears are case-hardened. The chuck can be readjusted by drawing the racks out of mesh with the gears, turning each screw the same number of teeth and then replacing the racks, but a safety device prevents drawing the racks out of mesh in use. It is not affected by centrifugal force. One plant is using 47 of these clutches at from 800 to 1000 revolutions per minute.

This is said to make a clutch which engages very gradually and without jar, and at the same time drives positively when fully engaged. It can be easily operated, as only a comparatively small movement of the spool is necessary to engage or release. This is being made by the Hilliard Clutch and Machinery Company, Elmira, N. Y.

Hand-driven Portable Slotting Machine

This machine has been found of great value not only for erecting and similar



HAND-DRIVEN PORTABLE SLOTTER

work, but it can also be used in place of a larger slotter in many shops where slotting work is confined to the cutting of keyways, oil grooves, etc., as it compares favorably with such a machine in capacity as well as accuracy. On erecting work the machine is used for cutting keyways in fly-wheels, oil grooves in pulleys, gears, etc., in place, but it is also adapted for work where heavy pieces are to be operated on. In this case the machine is brought to the work and clamped to it in any desired position.

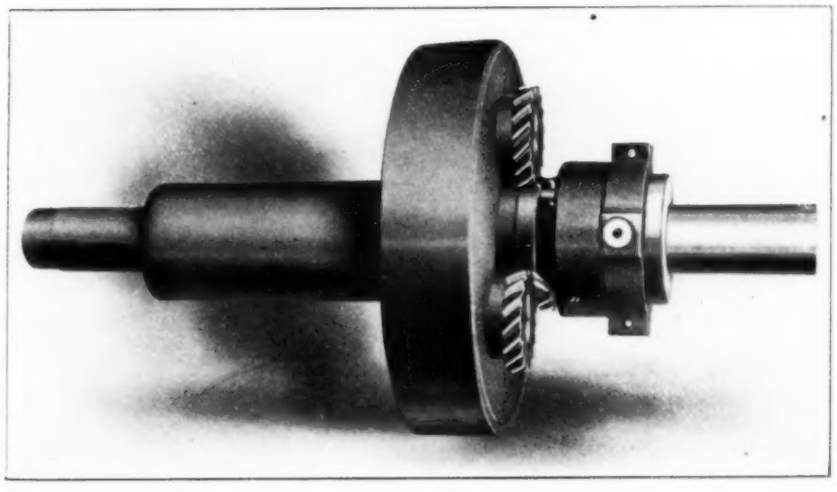


FIG. 1. A FRICTION CLUTCH WITHOUT TOGGLES

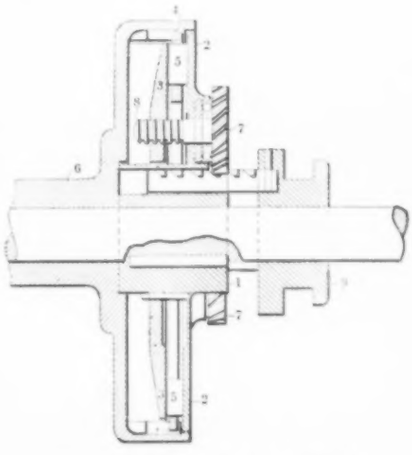


FIG. 2. DETAILS OF THE CLUTCH

The slide carrying the cutter bar is guided its full length from one end of the stroke to the other. The tool clears the cut on the return stroke. The feed is obtained by turning the little knob shown underneath the cutter bar, part of a revolution after each stroke. The cutter bar, which is reversible, carries the cutting tool direct on one side, while on the other side it is bored to receive a smaller bar for cutting grooves in smaller holes. The face plate to which the work is bolted is arranged to swivel and can be set at an angle to allow the cutting of grooves into taper holes.

This is made by Engels & Wægner, Berlin, Germany.

A New Method of Duplicating Prints

As a result of considerable experimenting the Multi-Color Copying Company, Detroit, Mich., have brought out what they call "Raven" prints, which are black on white, which can be changed with india ink without detection or colored without spreading the ink. They grew out of the old-time gelatin prints made in England in the '80s, and made on smooth paper or cloth with printer's ink, insuring durability.

The process consists of taking a print on a special prepared paper in the usual way from the tracing and of placing this print, without developing, on a plate coated with a glue-like composition. The print, having been smoothed down with a felt brush, is removed at once and an impression is left on the coating which takes printer's ink applied with an ordinary roller, while the background rejects it. From this impression from 25 to 50 copies can be taken by simply re-inking the impression each time a little after pulling off the copy. The composition can be easily removed, heated and used over again at least 25 times. By a special process copies can be transferred to a lithographic stone, zinc plate, etc., enabling the making of prints by machinery in large editions.

Hardening Multiple-throw Crank-shafts

By R. B. B. Little

Most automobile factories follow the practice of turning crank-shaft bearings to within a few thousandths of an inch of finished size before hardening. They are then hardened and ground to size.

In hardening the usual way the shaft is most sure to warp considerably when cooling. It has been found that in cooling, a great strain is exerted upon the shaft by the uneven temperature of the different parts throughout its length, and it is true that every shaft will warp a little, no matter how rigidly it is held.

The clamp shown in the line cut herewith is for holding the shaft during the hardening process, and it has been found in actual use that the clamp will reduce the warping to a minimum, and the small amount that the shaft does go out of true is readily straightened in the screw press after hardening.

Two of the bearings of the shaft are held in the clamp at *A A*. The clamping is accomplished by means of the leaf *B*, pin *C* and wedge *D*.

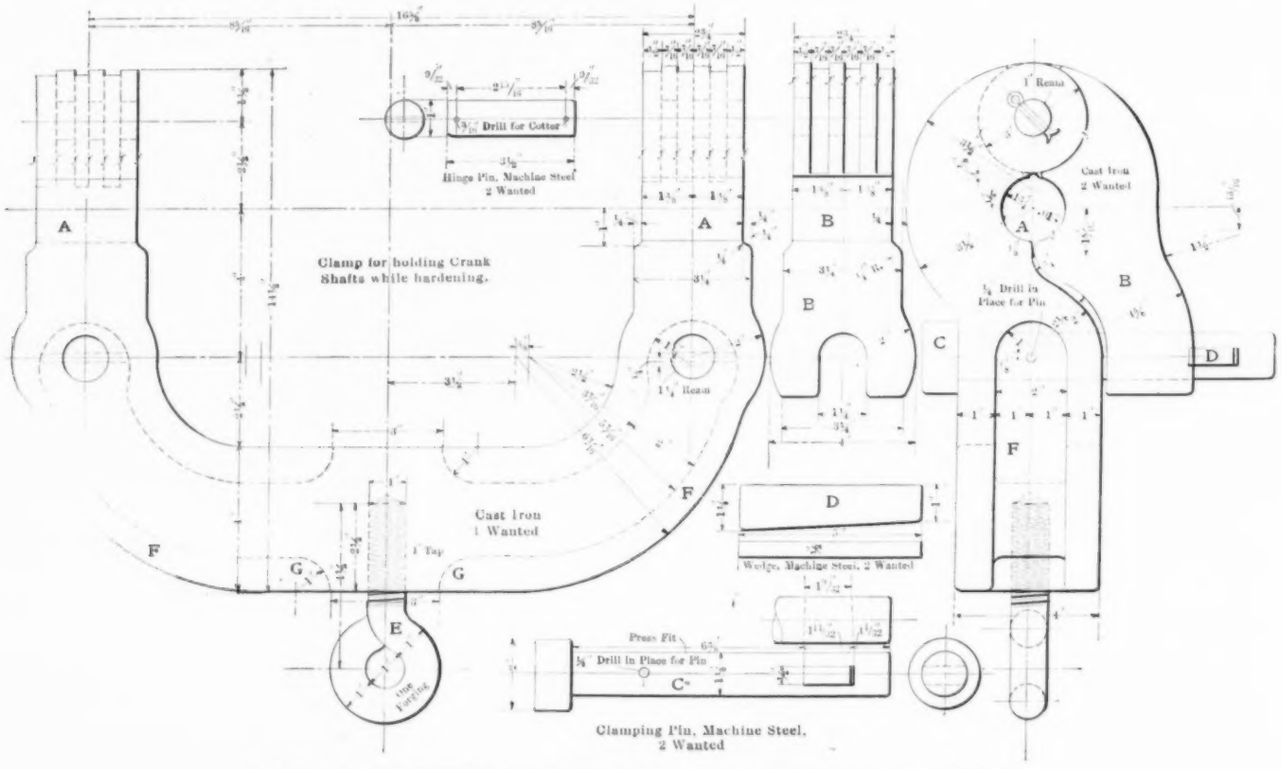
The leaf *B* and the holder *A* are both made of cast iron and should be designed in such a way as to secure the maximum amount of strength. The possibility of getting these parts too weak should be guarded against, as it is surprising to see the amount of force exerted in one of these shafts while cooling. I have seen them nearly as crooked as the proverbial ram's horn before we introduced the use of the clamp.

The whole fixture, with the shaft in place, is handled by a small portable crane, the eye-bolt *E* serving to lift it by.

After placing the shaft in the clamp so that two of the bearings come at *A A*, the bearings which are not in the clamp are put through the hardening process. After all the bearings of the shaft are hardened, except the two by which it is being held, the clamp is shifted to two other bearings and the two by which it was first held are hardened.

To insure against the clamp itself becoming too hot, two small streams of water are allowed to run down the grooves *F F*, they being trained on at points near the eye-bolt, as at *G G*.

If any of the bearings of the shaft are to be protected from the hardening process, they may be given a generous coating of fire clay.

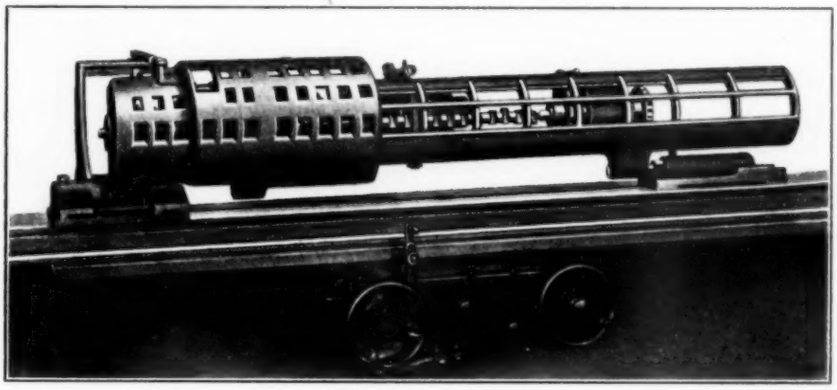


HOLDER FOR MULTIPLE-THROW CRANK-SHAFT WHILE HARDENING AND TEMPERING

Automatic Profile Grinding Attachment

This attachment is designed for grinding cams and other irregular profiles upon the plain cylindrical or universal precision grinding machines. It is a complete device adapted to suit any make of grinder, and consists of a self-contained frame complete with a live head center, and an adjustable center head suitable for carrying the cam-shafts or arbors between the centers. The frame is sensitively pivoted in centers, and oscillates truly and freely, without side- or back-lash; the work spindle is driven from the overhead motion in the same way that the ordinary live headstock is driven, and all the normal automatic motions, feed, and refined adjustments of the grinding machine, apply in every way as in cylindrical grinding. The work spindle runs in ball bearings with ball thrust washers, the bearings are well protected from dust, and require little or no attention for very long periods.

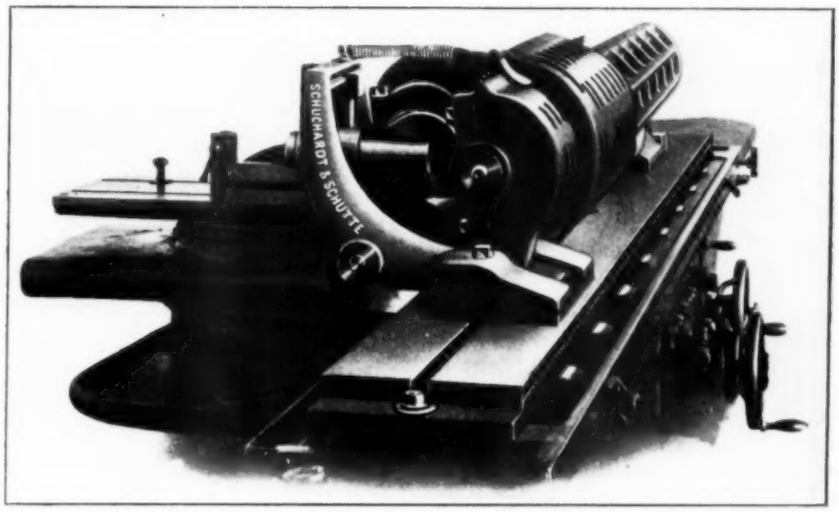
The master cams are carried upon a loosely fitting sleeve on the spindle at the outer end, and engage with a division plate fixed to the spindle, which sets the relative angular positions of the respective cams on the shaft to the correct relationship throughout. The sleeve is arranged to take four shapes of cams, which can be readily removed without disturbing the spindle. The master cam is held in contact with the idle roller by a long flexible spiral spring placed in a mean direct line over the cams. By an arrangement of pivoting the work frame sensitively in centers attached to the machine platen, the possibility of oblique stresses or side movement of the work frame is reduced to the minimum. The bracket carrying the idler roller absorbs any cross stresses due to the irregular movements of the cam axis, so that no vibration is transmitted to the various motions of the machine. Special steadies are provided for supporting long shafts, when required.



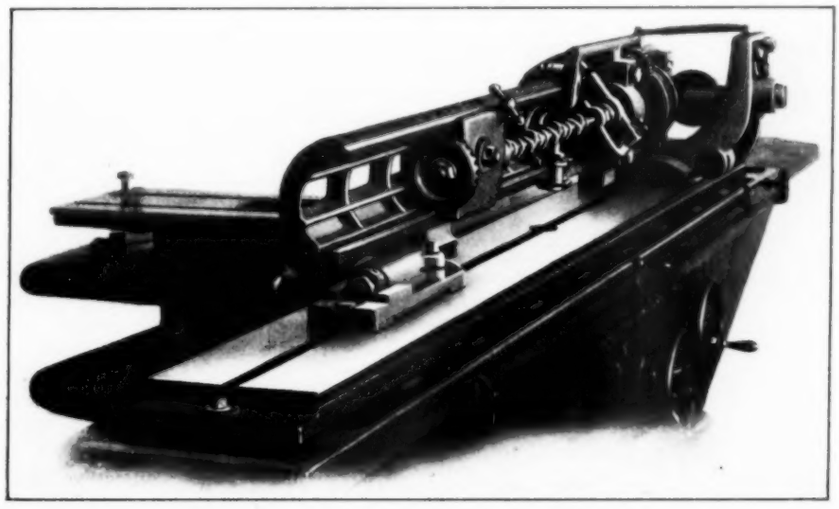
AUTOMATIC PROFILE GRINDING MACHINE

Ordinary grinding wheels up to 10 inches diameter may be used on convex shape cams; for concave faces of small radius, wheels as small as 1 inch diameter may be used on the ordinary internal grinding fixture, or on an extension spindle on the end of the main wheel arbor.

The master cam shapes may be produced by setting off with the compass in the usual way, or can be marked off in the attachment frame direct from the commercial cam shape, and after rough milling can be accurately ground up in place in the frame. The process of grinding and gaging the cam is precisely the same as grinding cylindrical work, the operator readily becomes familiar with all the operations involved.



BACK VIEW OF AUTOMATIC PROFILE GRINDER



FRONT VIEW OF AUTOMATIC PROFILE GRINDER

With this attachment irregular outlines can be as readily ground as cylindrical work. It effectively solves the problem of truing cam shapes readily and cheaply after hardening, and is also a cheap and accurate means for finishing soft cams, and is much better than filing, or a mere buffing-up process by hand, which, at best, must produce more or less inaccurate outlines.

This method mechanically works up the respective cams on the motor shaft into correct angular relationship with each other; insures that the form or contour of each cam is the same; that each cam can be accurately produced equal in size; that all the cams along the shaft shall be in strict mechanical alinement along

the shaft; that the faces of each cam are mechanically true in all respects.

It is clear that, assuming it may not much matter whether the surface of a cam be finished to a degree of accuracy within 0.01 inch or so, it is manifestly better to make it within 0.001 inch limit when the refinement costs little or no more than producing the coarser limits.

In operation, the true shape of the cam is developed under the correcting process of the grinding wheel and while the milling finish may appear to be correct, there is a very noticeable variation from the true form relative to the alinement and the common agreement of all the respective cams along the shaft.

The attachment is very simply fixed. The ordinary headstocks of the machine are slid out of the way or removed, and the belt driving the live head has a hinged joint, or a Jackson type wire joint may be used and secured by a simple pin, and no other part of the grinding machine is in any way interfered with in the setting up.

The attachment is adaptable to any of the well known grinding machines upon the market of the capacity of the work to be done, swinging 10 or 12 inches diameter, by 36 inches long and upward. The attachment swings ¼ to 4 inches diameter, and takes from 2 to 48 inches in length between centers.

This is made by Schuchardt & Schutte, 136 Liberty street, New York.

Measurements in Leather Belt Lacing

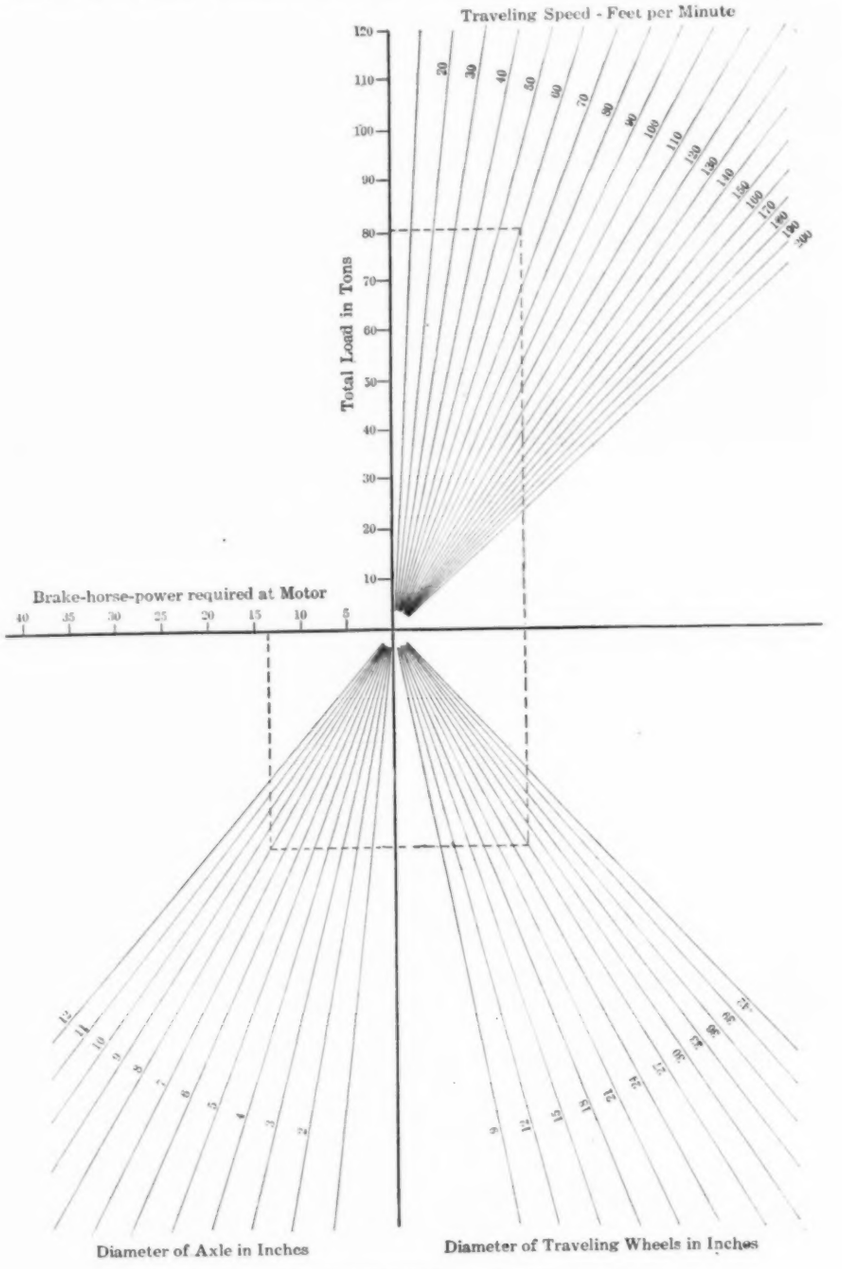
Steps have recently been taken by the Lace Leather Manufacturers' Association to publish the fact that members of the association guarantee full measure on all side or cut lace manufactured or sold by them. It was felt necessary to take such action in view of the increasing laxity of a few manufacturers in putting up bundles of cut lace supposed to contain 100 feet and in stamping the measurements of lacing sides. In this way they have been able to undersell more scrupulous manufacturers who were particular that their customers should get what they paid for. Unfortunately the practice has been winked at by some jobbers, who did not feel called upon to check the manufacturers' measurements in reselling the lace, especially as retailers and consumers rarely take the trouble to find out exactly what quantity they receive. The association is to be commended for coming out strongly against this abuse and the trade should coöperate with them by guarding against the purchase of short measure lace, which may continue to come on the market.

The production of pig iron during the first six months of 1907 was 13,478,044 tons. The production of the second half of 1907 was 12,303,317 tons.

Power Required by Cranes

By Albert D. Harrison

The accompanying chart is plotted to afford easy means for finding the brake horse-power required by hoists and cranes.


Traveling Speed - Feet per Minute
Total Load in Tons
Brake-horse-power required at Motor
Diameter of Axle in Inches
Diameter of Traveling Wheels in Inches

POWER REQUIRED BY CRANES

The equation from which values were derived to use in the plotting is:

Brake horse-power =

$$0.0097 \left\{ \frac{w\,S}{D} (d + 0.7) \right\}.$$

The coefficient of friction for rolling is assumed to be 0.035; the coefficient of friction for sliding is assumed to be 0.1; the efficiency of the gearing is assumed to be 70 per cent. In the equation W = the total weight of the moving structure, S = the speed in feet per minute, D = the diameter of the traveling wheels and d = the diameter of the axles.

The dotted line shows the method of tracing out the solution of a problem, in which the crane trolley weighs 20 tons, and is required to cross traverse with a load of 60 tons at a speed of 60 feet per minute. The diameter of the wheels is 27 inches and of the axles 8 inches. The total weight is thus 80 tons. The point representing this weight is located on the vertical scale in the upper part of the chart. A horizontal is traced to the right until it intersects the diagonal representing the speed required; in this case, 60 feet per minute.

From this intersection a vertical is dropped to the diagonal representing the diameter of the traveling wheels; in this

case 27 inches. From this intersection trace a horizontal to the left until it intersects the diagonal representing the diameter of the axle; in one example this diameter is 8 inches. A vertical from this point will intersect the horizontal scale of horse-power and the horse-power value may be read directly. In the example which we are tracing through the value is 13.5 horse-power.

When sponges are first torn from the seabed, they are of a dark color and living. By tramping them and pressing them with the feet a milky substance oozes out, whereupon the sponge dies. They are then immersed in the sea for a space of eight or ten hours. The dark, skinny substance is then removed by scraping and gradually, through cleaning, drying and bleaching, they take on the fine yellow color which characterizes many of them. It is said that the sponges taken from deep beds are better than those found in shallow water.

A general motor-car efficiency test on a standard model of touring car gave the general outcome on a model G standard touring car, on direct drive for 15.75 horse-power developed by the motor, 14.70 horse-power delivered at the ground; on intermediate drive the figures were 15.75 and 14.40. That meant a loss between motor and rear wheels of 6⅔ to 8½ per cent., or an efficiency for the total mechanism of 93.5 per cent. on direct and 91.5 per cent. on intermediate gear.

Business Items

Independent Pneumatic Tool Company, Chicago, Ill., will have a complete equipment of their "Thor" line of pneumatic tools at the M. M. and M. C. B. conventions, to be held at Atlantic City, N. J., June 17 to 24

O. S. Bickford, who recently opened a shop in Greenfield, Mass., for designing and building special machinery and tools, has sold a half interest to H. L. Washburn, until recently a toolmaker with Goodell-Pratt Company. The firm name will be Bickford and Washburn.

H. W. Caldwell and Son Company, of Chicago, Ill., engineers, founders, machinists and manufacturers of elevating, conveying and power-transmitting appliances, have opened a New England engineering and sales office, room 337, Oliver building, 141 Milk street, Boston, Mass., in charge of Malcolm R. White.

Francis and Company, Hartford, Conn., have closed out their hardware and machinist supply store on Main street, and have taken offices at 50 State street, Hartford, and will hereafter devote their entire business to the selling of carbons, Brazilian bortz and rough diamonds for all mechanical purposes, and diamond tools for truing grinding wheels.

The Hampden Machine Screw Company, Springfield, Mass., has been organized with a capital stock of $60,000. and will manufacture to order all kinds of special automatic screw machine products; also specialties on contract, such as spark plugs, electrical supplies, etc. The company has bought the good will and screw machine equipment of F. E. Wells and Son Company, of Greenfield, and has installed it as part of the equipment in the new factory, which is located at Arch street and Birnie avenue. John MacGregor, formerly superintendent of the Pope Manufacturing Company, at Westfield, is president and general manager; Arthur S. Bower, treasurer, and Stuart M. Robson, secretary.

Trade Catalogs

Philips Pressed Steel Pulley Works, Philadelphia, Pa. Pamphlet illustrating and describing Philips pressed steel pulley.

Allis-Chalmers Company, Milwaukee, Wis. Booklet describing works and products. Illustrated, 48 pages, 5x6½ inches, paper.

United Engineering and Foundry Company, Pittsburg, Penn. Catalog describing the making of rolls. Illustrated, 40 pages, 8½x10 inches, cloth.

Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Pamphlet describing Wirt Type dynamo brushes. Illustrated, 16 pages, 3½x6 inches, paper.

T. B. Wood's Sons Company, Chambersburg, Penn. Abridged Catalog No. 24, descriptive of power transmission appliances. Illustrated, 62 pages, 6x9 inches, paper.

General Electric Company, Schenectady, N. Y. Bulletin No. 4586 illustrating and describing flame arc lamp. Bulletin No. 4588 illustrating and describing GE 202 railway motor.

Wagner Electric Company, 6400 Plymouth avenue, St. Louis, Mo. Booklet, entitled "Vox Populi," containing testimonial letters regarding motors. 46 pages, 4x5 inches, paper.

The Foote-Burt Company, Cleveland, Ohio. Catalog describing Reliance bolt threading, pipe threading, nut tapping machinery and accessories. Illustrated, 54 pages, 6x9 inches, paper.

The Graton and Knight Manufacturing Company, Worcester, Mass. Booklet, entitled "Glimpses of Modern Belt Making," describing the making of leather belting. Illustrated, 24 pages, 3½x6 inches, paper.

Empire Metal Company, Syracuse, N. Y. Booklet, "Bearing on the Question," describing various alloys. Illustrated, 36 pages, 3½x6 inches, paper. Booklet giving directions for galvanizing iron with the hot dipping process. 8 pages, 3½x6 inches, paper.

Business Opportunities

The W. R. C. Automobile Works, El Reno, Okla., will erect a new plant.

The Tulsa (Okla.) Machine and Tool Company is building an addition.

Frank R. Hynes, Utica, N. Y., will put up a new up-to-date machine shop.

The Southern Pacific Railroad will build a new roundhouse at Gilroy, Cal.

The Miller Rubber Company, Akron, Ohio, will erect a three-story addition.

The Monroe (Mich.) Binder Board Company is erecting two additional buildings.

The Tips Foundry Company, Albany, Ga., will extend its gasolene engine plant.

The Evansville (Ind.) Furniture Company will put up a new seven-story building.

The Southern Wisconsin Foundry Company, Madison, Wis., will erect a new plant.

Henry Arnstein, Dayton, Ohio, will erect a factory to manufacture automobiles.

The Peerless Motor Car Company, Cleveland, Ohio, will erect a new factory building.

The Golden Furniture Company, Jamestown, N. J., will erect a five-story factory building.

The factory of the Hide-ite Leather Company, Brockton, Mass., was burned. Loss $40,000.

The American Type Founders Company, Jersey City, N. J., will build additions to its factory.

The Howard Manufacturing Company, Savannah, Mo., will erect a $50,000 stove factory in Omaha, Neb.

It is reported that the National Cash Register Company, Dayton, Ohio, is looking for a location in the East.

The plant of the Standard Sash and Door Company, Chicago, Ill., was destroyed by fire. Loss $100,000.

The Oliver Chilled Plow Works, Portland, Ore., has secured permit for a new building to cost $25,000.

Fire damaged the pipe shop of the Best Manufacturing Company, Pittsburg, Penn., to an extent of $75,000.

The Dayton (Ohio) Lumber and Manufacturing Company will rebuild plant recently destroyed by fire.

The Lambe-Fish Land Company, of Memphis, Tenn., will establish a box factory in Winton-Salem, N. C.

The planing mill of the Culpeper (Va.) Hardware and Manufacturing Company, was destroyed by fire. Loss $12,000.

Plans have been prepared by the Republic Iron and Steel Company, Youngstown, Ohio, for a new blowing mill.

The Buckeye Steel Casting Company, Columbus, Ohio, will soon let contract for the construction of a pattern shop.

The Union Tool Company, Los Angeles, Calif., has bought a site on which will be erected a warehouse and machine shop.

The tannery of the Green and Hickory Leather Company, Winchendon, Mass., was damaged by fire to an extent of $75,000.

Contract has been let for the construction of a $25,000 factory building for the Rebhun Last Company, Cincinnati, Ohio.

The Utah Light and Railway Company, Salt Lake City, Utah, will erect barns, carshops, etc., at a cost of about $600,000.

J. F. Galbraith, Shelbyville, Tenn., will put up a building and equip same with machinery for the manufacture of tin shingles.

Wm. H. Hushor, Rural Retreat, Va., manufacturing sheet metal goods, contemplates installing machinery for making tin cans.

The Denton (Texas) Woven Wire Fence Company has been incorporated with $25,000 capital by M. S. Stout, L. L. Fry and others.

The W. J. Savage Company, Knoxville, Tenn., has incorporated and will extend its factory for the manufacture of flour mill machinery.

It is reported the Jackson-Church Company, Saginaw, Mich., contemplates the erection of a modern boiler works plant to replace the present one.

The Jenney Electric Company, of Indianapolis, Ind., is having plans prepared for factory buildings to be erected in Anderson, Ind. These will cost about $50,000.

The Oil Well Supply Company, of Pittsburg, will erect new machine and blacksmith shop at its plant in Steubenville, Ohio. The latest machinery will be installed.

The Brandon (Mass.) Generator and Carbide Company has been incorporated to manufacture gas machines. William Platton, J. Herbert Ingram and others, directors.

The Business Men's Association of Pueblo, Colo., are negotiating for the establishment of a factory to manufacture a new sewing machine invented by E. C. Ives of that place.

It is reported that the Buffalo, Rochester and Pittsburg Railway Company has decided upon plans for proposed shops near Indiana, Penn. E. F. Robinson, Rochester, N. Y., chief engineer.

The New York Central and Hudson River Railroad Company has plans ready for a roundhouse at East Syracuse, N. Y., and one at Orvis, Penn. George W. Kittredge, New York, chief engineer.

The Cananea, Yaqui Riker & Pacific Railroad Company, has awarded contract for roundhouse, machine shops, etc., at El Palma. E. Randolph, Tuscon, Ariz., is president and general manager.

The United States Dry Galvanizing Company, New Castle, Penn., has been incorporated with a capital of $450,000. Charles J. Kirk, president. A plant to employ about 200 men will be established.

R. W. Hutchings and W. J. Stempson have purchased the foundry of Angelo Brothers, at Winston-Salem, N. C., and will operate as the Piedmont Foundry Company. It is proposed to install a machine shop.

Fire destroyed the main building containing the polishing room, nickeling and mounting room and carpenter shop at the plant of the Imperial Stove Works, Morrisburg, Ont. Rebuilding will be commenced immediately.

The McCord Manufacturing Company, St. Louis, Mo., will build a new plant which will involve an expenditure of $100,000. The company manufactures special tools for making plumbers' supplies and builders' hardware.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a. m., June 29, 1908, for upright drills, crank shapers, water tool grinders, rock drills, riveting hammers, boilers, twist drills, incandescent lamps, etc., as per Circular No. 446.

The Phillemac Rolling Mill Company has been formed and has leased a building at Glendale, Ohio, which will be equipped for manufacturing bar iron. J. P. McCaslin, Alexander La Mont, of Sharon, Penn.; and Myron Philips, of Youngstown, O., are organizers.

James S. Watson, manager of the drive chain department of the Link-Belt Company, has transferred his headquarters from the Philadelphia works to the company's chain manufacturing plant at Indianapolis. In his new field he will combine supervision of manufacture with direction of the selling force handling the Renold silent and roller chains.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

Perfect factory space to let. Robert J. Emory & Co., Newark, N. J.

If you use small gears in large quantities, write Berry & Parker, Erie, Pa.

Steel case hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Wanted—1 Old style No. 13 B. & S. Milling Machine. First-class condition not absolutely necessary. Box 234, AMERICAN MACHINIST.

Wanted—Machinery or machine parts to build by contract. Ideas developed; drawings made. Address "A," care AMERICAN MACHINIST.

We are equipped to turn out twice the number of gears used on our own work, can we do yours to fill in? Samuel M. Langston, Camden, N. J.

"Acme Automatic" users who wish to do left hand threading without attachments address R. H. Victory, 78 Mt. Vernon St., Lowell, Mass.

Wanted—Foundry and machine shop want orders for brass castings in quantities; also speed and monitor lathe work. Box 182, AMERICAN MACHINIST.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Have you a March 7, 1907 issue AMERICAN MACHINIST? We'll give you a month's subscription, or thirty cents, and a Steel supplement for it. AMERICAN MACHINIST, 505 Pearl street, New York.

Engineer, German-American, practical, with office at large German city, is wanting to represent first-class machine-tool builders in Germany and Austria. Can furnish A-1 references. Box 181, AMERICAN MACHINIST.

A large English firm of machine-tool importers having showroom and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Machinists take notice. Purchase castings and blueprints of high-grade gasolene motor, of world-wide reputation and at a profitable business. Write today. F. P. Conrad, 242 Freeport St., Harrison Sq., Boston.

We are looking about for some article or articles to take over. If you have something of merit, we will take up the financing, manufacturing and sale of it on any fair basis. "H. W. D.," AMERICAN MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris Sts., New York City.

Wanted—To purchase outright, or controlling interest in a growing business concern, which has been established for some years, and is able to show a dividend paying investment. Must stand the closest scrutiny. Prefer to leave the management as it is simply investing the capital. Will invest from $50,000 down. Address Box 222, AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Superintendency wanted by high-grade man up on costs and production. Box 220, AM. MACH.

Wanted—Position as works manager or superintendent by man having wide experience in building machinery and interchangeable parts. Can handle men to good advantage. Best of references furnished. Box 204, AMERICAN MACHINIST.

ILLINOIS

Position wanted by a practical mechanic and superintendent of an engine or electrical works or any other manufacturing plant. Box 229, AMERICAN MACHINIST.

INDIANA

Position wanted as draftsman or tool room foreman by a practical toolmaker, draftsman and designer. Seven years' experience, technical graduate, 31 years old. Box 226, AM. MACH.

MARYLAND

Superintendent, practical mechanic and executive, with the necessary experience to make your plant pay. Box 213, AMERICAN MACH.

MASSACHUSETTS

Designer and inventor of special and automatic machinery. Best of references. Box 230, AMERICAN MACHINIST.

Engineer having dealt chiefly with the manufacture of electrical machinery for eleven years, and has held executive positions, desires post as works superintendent or manager, or assistant in large factory. Accustomed to obtaining results. Willing to pay $50 to anyone through whom engagement is secured. Box 225, AM. MA.

NEW JERSEY

Mechanical draftsman wishes position. Box 232, AMERICAN MACHINIST.

Practical mechanic wants position as toolroom or general machine-shop foreman; long experience as executive and good designer of tools and labor-saving devices. Box 218, AM. MACH.

NEW YORK

Young mechanical draftsman wishes position. Box 233, AMERICAN MACHINIST.

Experienced tool and diemaker. First -class references. Box 223, AMERICAN MACHINIST.

Factory superintendent with the necessary experience to deliver the goods, desires change. Box 190, AMERICAN MACHINIST.

Expert mechanic, designer of special machinery and tools, desires change. Executive ability. Box 231, AMERICAN MACHINIST.

Position as factory manager or superintendent. Age 42. Twenty-four years' experience on good work. Good disciplinarian and cost reducer. Box 198, AMERICAN MACHINIST.

PENNSYLVANIA

Experienced tool designer desires position; six years' experience. Box 219, AM. MACHINIST.

VIRGINIA

A thorough up-to-date technical man with fifteen years' experience in the design and construction of cranes, coal handling machinery, mining machinery, steam shovels and dredges, desires to change. Would accept a position as chief engineer, chief draftsman, superintendent or inspector. Box 227, AM. MA.

WISCONSIN

Position as superintendent or works' manager by a thoroughly practical man of wide manufacturing experience. Is a hustler with a forte as a cost reducer, member of A.S.M.E.—A-1 reference. Box 214, AMERICAN MACHINIST.

FOREIGN

Coil-friction clutches.—English A.M.I.Mech.E., 32 years old, having had thirteen years' experience in the design, manufacture and installation of above for all purposes, from the highest of line shafting to the heaviest of rolling mill work, desires to obtain an appointment with a firm of general engineers interested in this specialty. No obsolete types, but all the latest and up to date, thousands of which are in use in the United Kingdom and on the continent. Full details, testimonials, references and photos will be forwarded if necessary. In addition to this particular line he is a rapid and accurate draftsman and calculator, and has had a practical and theoretical education,—works, drawing office, traveling, management of works and control of large numbers of workmen. Well versed in original design and modern methods. All offers for his services and interest to be addressed in first instance to Box 228, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—Two draftsmen, experienced on rolling and wire-mill machinery. Must have had at least six years' experience; must be rapid and accurate. Application must state age, experience in detail, references, salary required and date available. Box 191, AMER. MACHINIST.

DISTRICT OF COLUMBIA

Wanted—Ship draftsmen. Pay $2.00 to $5.04 per diem. An examination will be held July 14, 1908, for the purpose of establishing an eligible register for ship draftsmen and assistant ship draftsmen. For application and further information address, President of the Examining Board of Ship Draftsmen, Bureau of Construction and Repair, Navy Department, Washington, D. C.

ILLINOIS

Wanted—Salesmen visiting hardware, sheet-metal workers' and boilermakers' trade to carry as a side line our highly recommended modern portable hand metal punch. Indorsed and used by five largest U. S. navy yards and arsenals. Sells itself on merits. Send references. Only business getters answer. W. A. Whitney Mfg. Co., Rockford, Ill.

MISSOURI

Superintendent for our gas engine works, able to organize a perfect shop system, get work out economically and accurately; an ordinary shop foreman or theorist will not do. Salary $1800 upwards, chance for something else. Box 211, AMERICAN MACHINIST.

NEW YORK

Salesman wanted by dealer in power transmission machinery. State previous experience. Box 221, AMERICAN MACHINIST.

Wanted—As an assistant foreman, a first-class tool-maker who has had experience on building machinery and small tool work. Box 224, AMERICAN MACHINIST.

OHIO

Wanted—Superintendent and designer of screw machines and turret machinery. Box 217, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—Two men thoroughly experienced in the hobbing of pipe threading dies, also familiar with the various complications of high cutting

speeds. None but first-class men need apply. Highest wages paid. Box 216, AMERICAN MACH.

WISCONSIN

Wanted—Six good machinists for making jigs and fixtures for automobile parts. Want one of them capable of taking charge. Open shop. Thomas B. Jeffrey & Co., Kenosha, Wis.

FOREIGN

Power presses and sheet-metal working machinery. Wanted, by a large firm of power press manufacturers in England, a first-class draftsman, well up in automatic machinery; energetic, inventive; good encouragement for a first-class man; state age, experience, salary required. Box 215, AMERICAN MACHINIST.

For Sale

For Sale—One second-hand Uehling Steinbart & Company pneumatic pyrometer complete, with recording gage. Box 140, AMERICAN MACHINIST.

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Balancing Ways
Bowsher Co., N. P., South Bend, Ind.

Barrels, Steel
Lyon Metallic Mfg. Co., Aurora, Ill.

Barrels, Tumbling
Globe Machine & Stamping Co., Cleveland, O.

Bars, Boring
Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Krieger Tool & Mfg. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Bearings, Ball and Roller
Boston Gear Works, Norfolk Downs Mass.
Hyatt Roller Bearing Co., Harrison, N. J.
Iroquois Mach. Co., Providence, R.I.

Belt Dressing
Cling-Surface Mfg. Co., Buffalo, N.Y.
Desmond-Stephan Mfg. Co., Urbana, Ohio.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Fasteners
Bristol Co., Waterbury, Conn.

Belt Filler
Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine
Birdsboro Steel Foundry & Mach. Co., Birdsboro, Pa.

Belt Shifters
The L. & D. Co., Boston, Mass.

Belting, Leather
Chicago Raw Hide Mfg. Co., Chicago, Ill
Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Benches, Work
Manufacturing Equipment & Engineering Co., Boston, Mass.

Bending Machinery, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Plate
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

Bending Machines, Power
Bethlehem Foundry & Machine Co., South Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Bending Tools, Hand
Estep & Dolan, Sandwich, Ill.
Wallace Supply Co., Chicago, Ill.

Blocks, Chains
See Hoists, Hand.

Blocks, Die
Nicholson & Co., W. H., Wilkes-Barre, Pa.

Blowers
American Gas Furnace Co., New York,
Chicago Flexible Shaft Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York,
Roth Brothers & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Bolt and Nut Machinery
Acme Mchry. Co., Cleveland, O.
Boynton & Plummer, Worcester, Mass.
Davis Machine Co., W. P., Rochester, N. Y.
Foote-Burt Co., Cleveland, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Landis Machine Co., Waynesboro, Pa.
Manville Mach. Co., E. J., Waterbury, Conn.
McCabe, J. J., New York.
Milton Mfg. Co., Milton, Pa
Mummert, Wolf & Dixon Co., Hanover, Pa.
National-Acme Mfg. Co., Cleveland, O.
National Machinery Co., Tiffin, O.
Newton Machine Tool Wks., Inc., Phila., Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolt Heads
Lang & Co., G. R., Meadville, Pa.

Bolts and Nuts
Milton Mfg. Co., Milton, Pa.
National-Acme Mfg. Co., Cleveland, O.

Bone for Case Hardening
Rogers & Hubbard Co., Middletown, Conn.

Books, Technical
American School of Correspondence, Chicago, Ill.
Hill Publishing Co., New York.
Sames, Chas. M., Jersey City, N. J.

Boosters
Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Betts Mach. Co., Wilmington, Del.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Wilmington, Del.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Inc., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills, Vertical
American Tool Works Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Mitts & Merrill, Saginaw, Mich.
Newton Machine Tool Wks., Inc., Phila., Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Krieger Tool & Mfg. Co., Chicago Ill.

Boxes, Tote
Lyon Metallic Mfg. Co., Aurora, Ill.

Box Tools, Roughing
Bardons & Oliver, Cleveland, O

Brazing
Industrial Oxygen Co., New York.

Broaching Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Lapointe Mach. Tool Co., Hudson, Mass.

Bulldozers
Bliss Co., E. W., Brooklyn, N. Y.
National Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Lyon Metallic Mfg. Co., Aurora, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams
Bilgram, Hugo, Phila., Pa.
Boston Gear Works, Norfolk Downs, Mass.

Carborundum
See Grinding Wheels.

Carborundum Paper and Cloth
Carborundum Co., Niagara Falls, N. Y.

Case-Hardening
American Gas Furnace Co., New York.
Rogers & Hubbard Co., Middletown, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Castings, Brass and Bronze
Clum & Atkinson, Rochester, N. Y.
Lumen Bearing Co., Buffalo, N. Y.

Castings, Die Molded
Berry & Parker, Erie, Pa.
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Frdy. & Mach. Co., Birdsboro, Pa.
Cell Drier Machine Co., Taunton, Mass.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Taylor & Fenn Co., Hartford, Ct.

Castings, Steel
Birdsboro Steel Fdry. & Mach Co., Birdsboro, Mass.
Cammel, Laird & Co., New York.

Cast Iron Brazing
Industrial Oxygen Co., New York.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.
Obermayer & Co., S., Cincinnati, O.

Centering Machines
Hendey Mach. Co., Torrington, Conn.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer
Fay & Scott, Dexter, Me.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

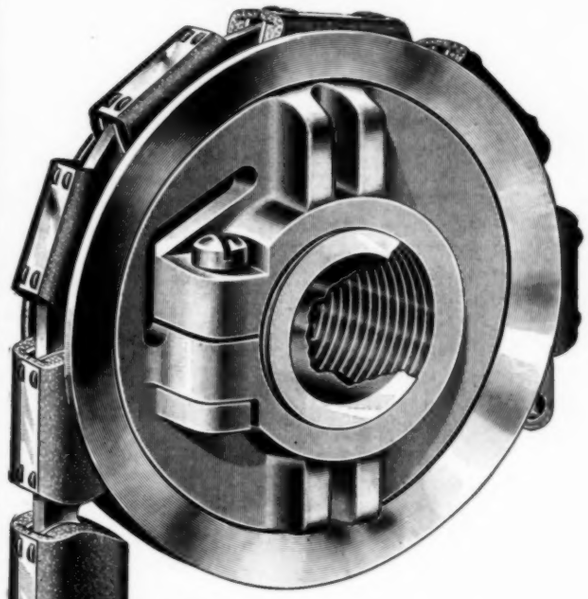
Chains, Driving
Boston Gear Works, Norfolk Downs, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Conn

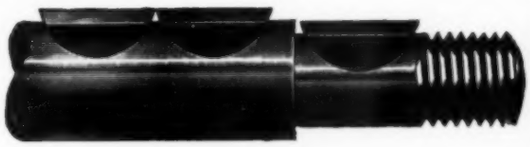
Chucking Machines
American Tool Wks. Co., Cin., O.
Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

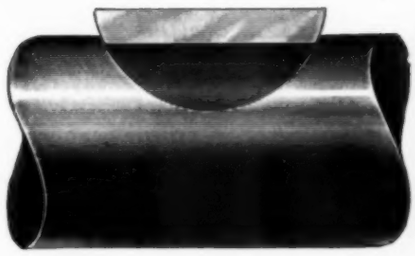
Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Celfor Tool Co., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Grönkvist Drill Chuck Co., Jersey City, N. J.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn

New "Whitney" Chain Belt

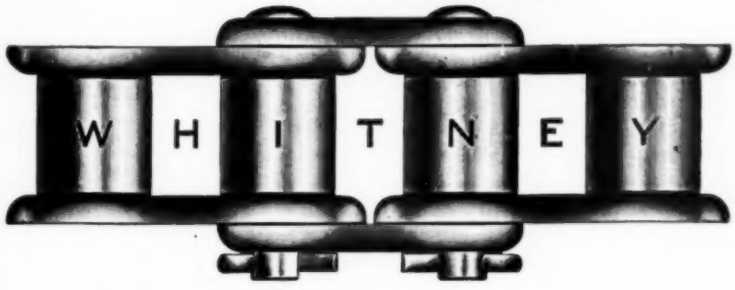
For Cooling Fans, Oiling Devices, Motorcycles, Etc.







PATENTS PENDING



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Better results and a great saving in cost.

We carry 95 regular sizes of Keys and Cutters in stock for immediate delivery.

"Whitney" Patent Cotter Detachable Roller Chains

Made a fine record in the Briarcliff Road Race.

THE WHITNEY MFG. COMPANY,
Hartford, Conn.

New York City, May 2, 1908.

Gentlemen—The uniform strength of an automobile driving chain is one of the important requisites in a speed contest.

The "Whitney" Chains which formed a part of the equipment on our three "Stearns" Cars in the recent Briarcliff Stock Car Road Race, showed their superiority by coming through this exceptionally difficult contest without the slightest evidence of the terrific strain which they had undergone. Our "Stearns" Cars made an exceptional showing in this race, and we attribute our success in no small degree to the entire absence of chain trouble.

Our experience in previous contests has taught us that a faulty chain can cause a lot of trouble.

We therefore take this opportunity to express the satisfaction which we feel at the manner in which "Whitney" Chains demonstrated their worth.

Yours very truly,
WYCKOFF, CHURCH & PARTRIDGE,
By C F. Wyckoff, President.

THE WHITNEY MFG. COMPANY, Hartford, Conn.

Chucks, Drill—*Continued.*
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitman & Barnes Mfg. Co., Chicago, Ill.
Whitney Mfg. Co., Hartford, Conn.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe

Cincinnati Chuck Co., Cincinnati, O.
Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer

Harrington & Son Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split

Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.

Circuit Breakers

Crocker-Wheeler Co., Ampere, N. J
General Electric Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps

Hammacher, Schlemmer & Co., New York.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Starrett Co., L. S., Athol, Mass.
Tudor Mfg. Co., Taunton, Mass.
Williams & Co., J. H., Brooklyn, N Y.

Clocks, Watchman's

Hardinge Bros., Chicago, Ill.

Clutches, Friction

American Tool & Machine Co., Boston, Mass.
Bliss Co., E. W., Brooklyn, N. Y.
Caldwell, Son & Co., W. H., Chicago, Ill.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Williams Foundry & Machine Co., Akron, Ohio.

Coal Handling Machinery

Link-Belt Co., Philadelphia, Pa.

Compound, Core

Obermayer Co., S., Cincinnati, O.

Compound, Pipe Joint

Dixon Crucible Co., Joseph, Jersey City, N. J.

Compressors, Air

Blaisdell Machinery Co., Bradford, Pa.
Blanchard Machine Co., Cambridge, Mass.
Bury Compressor Co., Erie, Pa.
Clayton Air Compressor Works, New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas

Blaisdell Machinery Co., Bradford, Pa.
Ingersoll-Rand Co., New York.

Cones, Friction

Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps

Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work

Blanchard Mach. Co., Cambridge, Mass.
Cell Drier Mach. Co., Taunton, Mass.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Manville Bros. Co., Waterbury, Conn.
Merritt, Jos., Hartford, Conn.
Turner Mach. Co., Danbury, Conn.

Controllers and Starters, Electric Motor

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveyors, Automatic

Lamson Consolidated Store Service Co., Boston, Mass.
Link-Belt Co., Philadelphia, Pa.

Coping Machines

Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Corundum

See Grinding Wheels.

Cotters

Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores

Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Counters, Revolution

Root Co., C. J., Bristol, Conn.
Schuchardt & Schutte, New York.
Veeder Mfg. Co., Hartford, Conn.

Countershafts

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O
McCabe, J. J., New York.
Mossberg Wrench Co., Central Falls, R. I.
Norton Grinding Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction

Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing

Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose

Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

Couplings

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Davis Machine Co., W. P., Rochester, N. Y.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkes-Barre, Pa.

Couplings—*Continued.*
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Williams Fdry. & Mach. Co., Akron, Ohio.

Cranes

Brown Hoisting Mach. Co., Cleveland, O.
Case Mfg. Co., Columbus, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Franklin Port. Crane and Hoist Co., Franklin, Pa.
Manning, Maxwell & Moore, Inc., New York.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines

Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts

Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles

Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers

Farrel Fdry. & Mach. Co., Ansonia, Conn.
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry

Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups, Grease

Lunkenheimer Co., Cincinnati, O.

Cutters, Milling

Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bliss Mfg. Co., E. C., Providence, R. I.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Harrison & Knight Mfg. Co., Newark, N. J.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M.; Gloucester City, N. J.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Ward & Son, Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines

Armstrong Bros. Tool Co., Chicago, Ill.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Machine Co., W. P., Rochester, N. Y.
Hurlburt-Rogers Mach. Co., South Sudbury, Mass.
McCabe, J. J., New York.
Newton Mach. Tool Wks., Inc., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Schmitz, August, Dusseldorf, Germany.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.

Cutting-off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Fitchburg Machine Works, Fitchburg, Mass.
Krieger Tool & Mfg. Co., Chicago, Ill.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools

American Emery Wheel Co., Providence, R. I.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O.

Dies, Sheet Metal

American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Consolidated Press and Tool Co., Hastings, Mich.
Ferracute Mach. Co., Bridgeton, N. J.
Globe Machine & Stamping Co., Cleveland, O.
Manville Bros. Co., Waterbury, Conn.
Risdon Tool Works, Waterbury, Conn.

Dies, Sub-Press

Risdon Tool Works, Waterbury, Conn
Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Errington, F. A., New York.
Foote-Burt Co., Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Drawing Boards and Tables

Alteneder & Son, Theo., Philadelphia, Pa.
Kolesch & Co., New York.

Drawing Materials

Alteneder & Son, Theo., Philadelphia, Pa.
Kolesch & Co., New York.
Technical Supply Co Scranton, Pa.

Drafting Machines

Universal Drafting Mach. Co., Cleveland, O.

Drilling Machines, Bench

American Watch Tool Co., Waltham, Mass.
Barnes Co., W. F. & John, Rockford Ill.
Boynton & Plummer, Worceste Mass.
Ingersoll-Rand Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Boiler

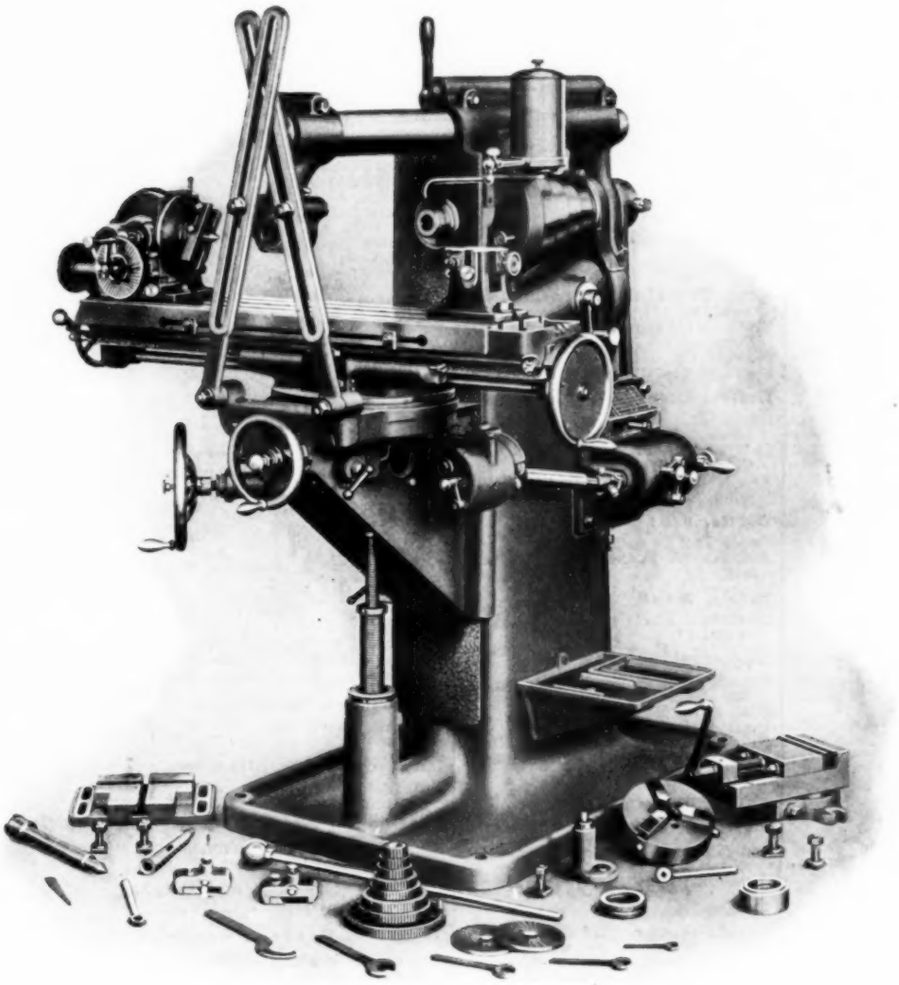
American Tool Works Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, O.
Ingersoll-Rand Co., New York.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Multiple Spindle

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Flather Planer Co., Mark, Nashua, N. H.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.

BROWN & SHARPE MFG. CO.,

PROVIDENCE, R. I., U. S. A.



Quality of the Finished Product is the first consideration in the design of all

B. & S. UNIVERSAL MILLING MACHINES.

While it is important many times to know the capacity of a machine and how rapidly it will turn out work, it is the QUALITY of the work that has to stand inspection.

Circulars, describing any of the B. & S. Milling Machines, will be sent to any address upon application.

Drilling Machines, Multiple Spindle—*Continued.*

Hardinge Bros., Chicago, Ill.
Harrington Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschardt Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.

Drilling Machines, Portable

Cincinnati Elec. Tool Co., Cin., O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Newton Machine Tool Wks., Inc., Phila., Pa.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial

American Tool Works Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Kilbert Mach. Co., Cincinnati, Ohio.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Foundry Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Newton Machine Tool Wks., Inc., Phila., Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co, Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Mchy. Co., C. C., Detroit, Mich.

Drilling Machines, Rail

Foote-Burt Co., Cleveland, O.
Newton Machine Tool Wks., Inc., Phila., Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Standard Tool Co., Cleveland, O.

Drilling Machines, Turret

Fay Machine Tool Co., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright

American Tool Works Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Boynton & Plummer, Worcester, Mass.
Celfor Tool Co., Chicago, Ill.
Cincinnati Mach. Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Davis Machine Co., W. P., Rochester, N. Y.
Fosdick Mach. Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Kern Mach. Tool Co., Cincinnati, O.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.

Drilling Machines, Upright —*Continued.*

McCabe, J. J., New York.
Mechanics Machine Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co , Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Taylor & Fenn Co., Hartford, Conn.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Wormer Mchry. Co., C. C., Detroit, Mich.

Drills, Center

Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Electric

Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Independent Pneumatic Tool Co., Chicago, Ill.
Van Dorn Elec. Mfg. Co., Cleveland, Ohio.

Drills, Flat

Celfor Tool Co., Chicago, Ill.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Drills, Hand

Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic

Clayton Air Compressor Works, New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

Drills, Ratchet

Armstrong Bros. Tool Co., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock

Ingersoll-Rand Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.

Drill Speeder

Graham Mfg. Co., Providence, R. I.

Drying Apparatus

Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies

Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cincinnati, O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Triumph Electric Co., Cincinnati, O.
Van Dorn Elec. & Mfg. Co., Cleveland, Ohio.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg Co., Pittsburg, Pa

Electrically Driven Tools and Machinery

American Tool Works Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Roth Bros. & Co., Chicago, Ill.
U. S. Electrical Tool Co., Cincinnati, O.
Van Dorn Elec. & Mfg. Co., Cleveland, Ohio.
Western Electric Co., Chicago, Ill.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa.

Emery Wheels

See Grinding Wheels.

Emery Wheel Dressers

American Emery Wheel Co., Providence, R. I.
Bay State Stamping Co., Worcester, Mass.
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vitrified Wheel Co., Westfield, Mass.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-Room

Hart & Cooley Co., New Britain, Conn.

Engineering Appliances

Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Engineers, Mechanical and Electrical

Crocker-Wheeler Co., Ampere, N. J.
Merritt, Jos., Hartford, Conn.

Engines, Gas and Gasolene

Automatic Mach. Co., Bridgeport, Conn.
Blaisdell Machinery Co., Bradford, Pa.
Grant Mfg. & Mach. Co., Bridgeport, Conn.

Engines, Motor

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Engines, Steam

Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery

Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads

Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery

Philadelphia Bourse, Phila., Pa.

Expanders, Tube

Nicholson & Co., W. H., Wilkes-Barre, Pa.

Export

C. I. F. Co., New York.

Eyelet Machinery

Manville Bros. Co., Waterbury, Conn.

Factory Equipment

Lyon Metallic Mfg. Co., Aurora, Ill.
Mfg. Equipment & Eng. Co., Boston, Mass.

Fans, Electric

Crocker-Wheeler Co., Ampere, N. J
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., Phila., Pa.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago, Ill.

Files and Rasps

Barnett Co., G. & H., Phila., Pa.
Carver File Co., Philadelphia, Pa.
Hammacher, Schlemmer & Co., New York.
Nash Co., Geo., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.
Simonds File Co , Fitchburg, Mass.

Filing Machines

Henry & Wright Mfg. Co., Hartford, Conn.
Robinson Tool Works, Waterbury, Conn.

Filler, Iron

Clark Cast Steel Cement Co., Shelton, Conn.
Felton, Sibley & Co., Philadelphia, Pa.

Flexible Shafts

Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.

Forges

Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
National Machinery Co., Tiffin, O.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop

Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Crescent Forgings Co., Oakmont, Pa.
O. K. Tool Holder Co., Shelton, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Forgings, Steel

Cammel, Laird & Co., New York.
Crescent Forgings Co., Oakmont, Pa.
McInnes Steel Co., Corry, Pa.
Tindel-Morris Co., Eddystone, Pa.

Foundry Furnishings

Adams Co., Dubuque, Iowa.
Goldschmidt Thermit Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Frictions, Paper and Iron

Rockwood Mfg. Co., Indianapolis, Ind.

Furnaces, Annealing and Tempering

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash Co., Geo., New York.
Tate, Jones & Co., Pittsburg, Pa.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Enameling

American Gas Furnace Co., New York.

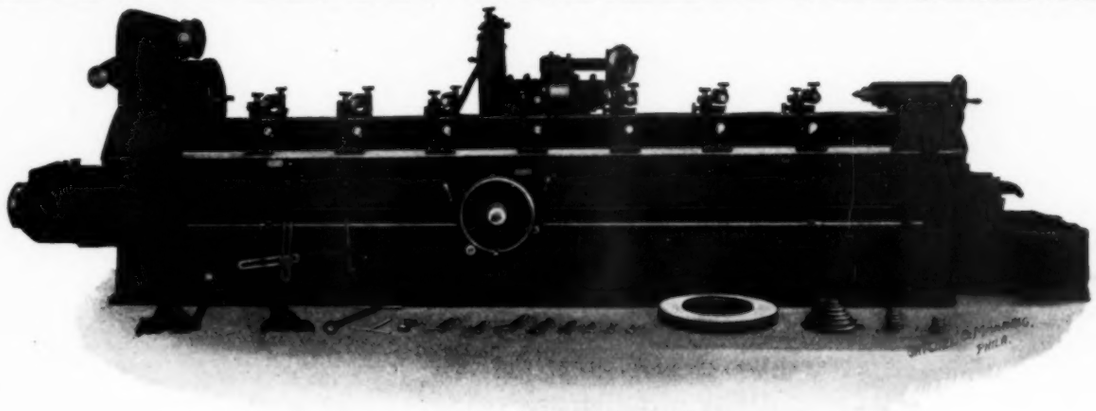
Furnaces, Gas

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Rockwell Furnace Co., New York.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Melting

American Gas Furnace Co., New York.
Nash Company, Geo., New York.
Obermayer Co., S., Cincinnati, O.
Westmacott Gas Furnace Co., Providence, R. I.

LARGE PLAIN GRINDING MACHINES



These large machines have many advantages and are best adapted to the heavier class of cylindrical grinding.

They are equipped with automatic wheel feed that feeds at each reversal of the wheel carriage and can be adjusted to take cuts from .00025″ to .006″ deep.

The grinding wheels used are from 2″ to 3″ face and 24″ in diameter.

The work as well as the traverse speeds can be obtained while machine is in motion.

We build this style of machine in three different sizes 72″, 96″ and 144″ between centers all of which are 20″ swing.

Let us send you our book on grinding which is full of information.

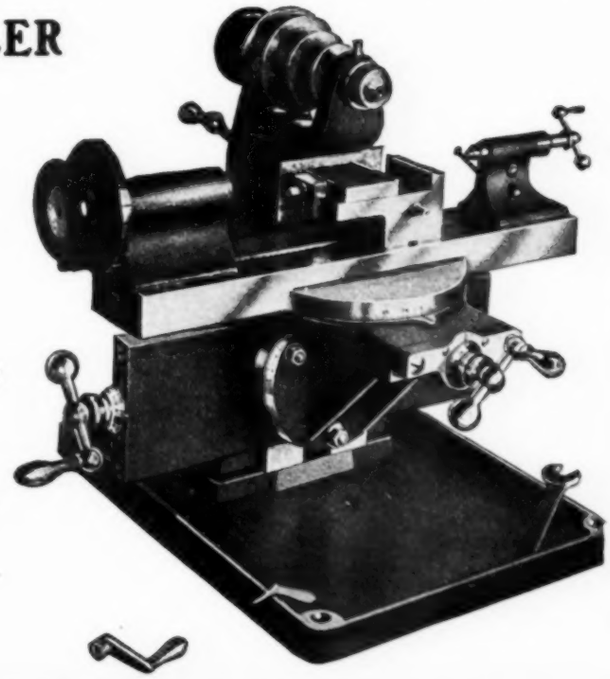
LANDIS TOOL COMPANY, - Waynesboro, Pa., U. S. A.

AGENTS—Marshall & Huschart Machinery Co., 64 So. Canal St., Chicago, Ill., St. Louis, Mo., Indianapolis, Ind. Walter H. Foster Co., 50 Church St., New York. C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg, Copenhagen and Budapest. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Paris and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.

On The "Hundred And One" Small Jobs Of The Tool Room

THE S. & C. BENCH MILLER

does extremely fast, accurate work with greatest convenience and ease of operation. Travels: Vertical 7″, Longitudinal 10″, Transverse 4¾″; Weight 308 lbs.
Collets, arbors, etc., are interchangeable with those of our No. 5½ Bench Lathe. *Catalog?*



We also make Bench Lathes, Drill Presses, Tapping Machines, Automatic Gear and Rack Cutters, Sub-Press Dies, Special Tools, etc.

Sloan & Chace Mfg. Company, Ltd.,

Precision Machinery and Special Tools.

NEWARK, N. J., U. S. A.

Furnaces, Oil

Rockwell Furnace Co., New York.
Tate, Jones & Co., Pittsburg, Pa.

Furniture, Machine Shop

Hart & Cooley Co., New Britain, Conn.
Lyon Metallic Mfg. Co., Aurora, Ill.
Manufacturing Equip. & Engineering Co., Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gages, Recording

Bristol Co., Waterbury, Conn

Gages, Standard

Ames & Co., B. C., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Grönkvist Drill Chuck Co., Jersey City, N. J.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Wks., Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., East Boston, Mass.

Gages, Steam

Bristol Co., Waterbury, Conn.
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery

Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bilgram, Hugo, Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Buffalo Gear & Pattern Works, Buffalo, N. Y.
Cincinnati Shaper Co., Cincinnati, Ohio.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Mach. Co., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Morse Williams & Co., Philadelphia, Pa.
Newton Machine Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Van Dorn & Dutton Co., Cleveland, O.
Walcott & Wood Mach. Tool Co., Jackson, Mich.
Waltham Machine Works, Waltham, Mass.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery

Gisholt Mach. Co., Madison, Wis.

Gears, Cut

Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Buffalo Gear & Pattern Works., Buffalo, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Davis Rodney, Philadelphia, Pa.
Earle Gear & Machine Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.

Gears, Cut —*Continued.*

Foote Bros. Gear & Machine Co., Chicago, Ill.
Gleason Works, Rochester, Mass.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, Ohio.
Lea Equipment Co., New York.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Works, Cleveland, O.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.
Walcott & Wood Mach. Tool Co., Jackson, Mich.

Gears, Molded

Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Horsburgh & Scott Co., Cleveland, Ohio.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Rawhide

Boston Gear Works, Norfolk Downs, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Horsburgh & Scott Co., Cleveland, O.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Works, Cleveland, O.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Worm

Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Eberhardt Bros. Mach. Co., Newark, N. J.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, O.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Generating Sets

Burke Electric Co., Erie, Pa.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas

American Gas Furnace Co., New York.

Graphite

Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center

Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Gem Mfg. Co., Pittsburg, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
Mueller Machine Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cin., O.

Grinders, Cutter

Bath Grinder Co., Inc., Fitchburg, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll Milling Mach. Co., Rockford, Ill.
McCabe, J. J., New York.
National Machine Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Norton Grinding Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
U. S. Electrical Tool Co., Cincinnati, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Cylindrical

Bath Grinder Co., Inc., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disc

Bath Grinder Co., Inc., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Diamond Machine Co., Providence, R. I.
Gardner Machine Co., Beloit, Wis.
Heald Mach. Co., Worcester, Mass.
Iroquois Mach. Co., Providence, R. I.
Safety Emery Wheel Co., Springfield, Mass.
Taylor & Fenn Co., Hartford, Conn.

Grinders, Drill

Heald Mach. Co., Worcester, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Robinson Tool Works, Waterbury, Conn.
Safety Emery Wheel Co., Springfield, Ohio.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
U. S. Electrical Tool Co., Cincinnati, Ohio.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal

Bath Grinder Co., Inc., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Iroquois Mach. Co., Providence, R. I.
Landis Tool Co., Waynesboro, Pa.
Rivett Lathe Mfg. Co., Boston, Mass.
U. S. Electrical Tool Co., Cincinnati, O.

Grinders, Knife

American Wood Working Mchy. Co., Rochester, N. Y.
Safety Emery Wheel Co., Springfield, O.

Grinders, Portable

Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
U. S. Electrical Co., Cincinnati, Ohio.

Grinders, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Inc., Fitchburg, Mass.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Cincinnati Milling Machine Co., Cincinnati, O.

Grinders, Tool —*Continued.*

Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Diamond Machine Co., Providence, R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Iroquois Mach. Co., Prov., R. I.
Landis Tool Co., Waynesboro, Pa.
McCabe, J. J., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Mummert, Wolf & Dixon Co., Hanover, Pa.
Niles-Bement-Pond Co., New York.
Norton Grinding Co., Worcester, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Robinson Tool Works, Waterbury, Conn.
Rockford Drilling Mach. Co., Rockford, Ill.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Tabor Mfg. Co., Phila., Pa.
U. S. Electrical Tool Co., Cincinnati, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding or Polishing Machinery

Abrasive Material Co., Philadelphia, Pa.
American Emery Wheel Co., Providence, R. I.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Inc., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders Iron Foundry, Providence, R. I.
Chicago Machine Tool Co., Chicago, Ill.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Machine Co., Providence, R. I.
Gardner Mach. Co., Beloit, Mich.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Inc., Boston, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
Iroquois Mach. Co., Providence, R. I.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
National Machine Co., Hartford, Conn.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Norton Grinding Co., Worcester, Mass.
Pittsburg Emery Wheel Co., Pittsburg, Pa.
Prentiss Tool & Supply Co., New York.
Robinson Tool Works, Waterbury, Conn.
Roth Bros. & Co., Chicago, Ill.
Safety Emery Wheel Co., Springfield, O.
U. S. Electrical Tool Co., Cincinnati, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.

Grinding Wheels

Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
American Emery Wheel Co., Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Machine Co., Providence, R. I.
Dickinson, Thos. L., New York.
Niles-Bement-Pond Co., New York.
Norton Co., Worcester, Mass.